Effectiveness of Prequalification Practices in Public Procurement

by

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Abstract

Due to legally restrictive nature of public work, contracts are often awarded solely based on the price of the bid. This has often resulted in contracts being awarded to less qualified contractors. Between the practices developed to deal with this issue, prequalification has proven to be one of the most effective practices in dealing with this problem. As it was investigated in this research, practice of prequalification is widespread amongst the public owners in the region. However, an in-depth look at the practices has revealed that these owners are not currently using this process to its fullest potential and integration of some of the best practices suggested in this paper has the potential to make this process more effective. This research also contains a specially fabricated model which encumbers all of the suggested practices and aims at creating a simple, practical and transparent model for the public owners in the Southern Ontario region.

Acknowledgments

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Introduction

1 Introduction

Although some projects might be served better with a different contracting strategy, the public sector in Ontario and in Canada tends to work with the traditional design-bid-build model (Bedford, 2009). The lowest bid award system (LB) is the most common procurement model as it is believed to foster competition, lower bids, and introduce cost saving innovations. Due to the transparent nature of this process, LB is preferred in the public sector because it satisfies public policies.

The issues with LB rise out of its one dimensional focus in awarding contracts solely on the cost; hence important factors such as time and quality are ignored, raising the possibility of unqualified contractors participating in the bidding process. Some have argued that instead of promoting competition, LB can attract too many bidders which ultimately reduces the attractiveness for some of the highly qualified contractors by reducing the probability of winning the bid (Gong 1999).

1.1 Prequalification

Prequalification has become one of the more common ways to deal with shortcomings of the LB system. Prequalification is a pre-tender process that aims to assess the capability and competence of potential bidders through screening of contractors according to a given set of criteria (Russell & Skibniewski, 1988; Hatush & Skitmore, 1997). Ultimately this process acts as a tool for the owner to select a group of contractors with the capability and means of successfully finishing the project, ensuring that the bid winner has the ability to deliver the contract (Hatush & Skitmore, 1997). If used effectively (i.e. using selection criteria that truly assess the contractors' ability to successfully complete the project), prequalification can assist in reducing the bid cost while retaining the benefits of pure competition.

Prequalification can reduce the complexity of the contracts, as the early screening of the contractors allows selection of a contractor who is able to execute the assigned project in

accordance with all project requirements. On the other hand, poor selection of the contractor can result in magnification of the problems encountered during the project; no matter how meticulously the contract has been drawn (Russell et al. 1992). This process also has the potential to reduce the number of bidders, without undermining the legality and fairness of the bidding process, through consideration of transparent and predefined criteria that evaluate the candidate's capabilities.

1.2 Selection Criteria

Although prequalification criteria have been extensively reviewed in the literature, there is little agreement as to which categories are more effective than others. Table 1 shows 8 common categories ranked by how frequently they appear in the literature, with 1 ranking the highest.

Table 1: General Categories: Literature

Category	**Symbol**	**Rank**
Financial stability	FIN	1
Experience and past performance	EXP	2
Company organization	ORG	3
Health and safety	H&S	4
Capacity of the contractor	CAP	5
Management capabilities	MGT	6
Project control procedures	PCP	7
Geographic location	GEO	8

The criteria that appear most often in the literature are presented in table 2 along with the category into which they fit.

Table 2: Criteria Ranking: Literature

Rank	Criteria	Category
1	Key Personnel Experience	MC
2	Banking Arrangements	FIN
3	Financial Statements	FIN
4	Company Image	EXP
5	Adequate Equipment Available	CAP
6	Number of Years in Construction	ORG
7	Credit Rating	FIN
8	Bonding Capacity	FIN
9	Number of Times Contractor has Met Cost	EXP
10	Number of Times Claims Gone to Litigation	EXP
11	Appropriateness of Control/Policy/Assurance Program	PCP

Although many owners rely on surety bonds as a proxy for prequalification, bonding capacity has only moderate importance - bonding capacity alone is not a good indicator of financial stability (Russell & Skibniewski, 1988). One other significant finding was that geographic location and experience in that geographic location are considered the least important categories (Russell, Hancher, & Skibniewski, 1992; Hatush & Skitmore, 1997; Jennings & Holt, 1998). However, this is contrary to expectations as public owners are pressured to hire local contractors (Russell & Skibniewski, 1988). There is a strong correlation between the views of contractors and owners regarding prequalification criteria (Jennings & Holt, 1998). Both parties found experience and past performance as the most important category in the prequalification process. However, there are conflicting findings about financial stability's perceived level of importance. Similar to the view of owners, financial stability is viewed by contractors as a very important selection criteria, and private owners view financial stability, experience and past performance as the most important criteria in the prequalification process. However contradicting views were found on health and safety, as private owners ranked it low. Differences in the view of public owners and private owners could be due to different project objectives, both internally and externally, held by each party (Russell, Hancher, & Skibniewski, 1992).

1.2.1 --- Criteria Development through Contractor/Owner Cooperation

Major differences exist between the perceptions of owners and contractors about the cost to the contractors of providing the prequalification data and the benefit it provides the owner in assessing the contractor's qualifications. Owners may ask for information that is difficult to collect and provides them with limited insight to the qualifications of the contractor. It is suggested that owners undertake cost benefit analysis of the criteria and that they eliminate those criteria that provide insignificant and limited benefits for the owner. It is suggested that involving contractors in the development of a new prequalification process may improve the effectiveness of the resulting process (Ng & Skitmore, 2001).

1.3 Existing Prequalification Models

This section will present an overview of existing prequalification models, including their advantages and disadvantages. It is important to note that prequalification is different than other multi-criteria problems and the decision making method used should be able to deal with uncertain, incomplete or imprecise assessments that might be present. Prequalification decision making is a nonlinear two group classification problem because the relation between the contractors attributes and the corresponding decisions have a nonlinear relationship (Lam et al. 2000).

Dimensional weighting aggregation model (DWA) is one of the earlier prequalification models and it uses the weighted sum of overall decision parameters to calculate the contractor's aggregate rating. This model is simple however it is highly subjective and cannot compensate for the risks in decision maker's opinions or the inconsistencies in the contractor's data (Russell & Skitbniewski, 1990). Knowledge based system (KBS) was developed with the objective of overcoming the disadvantages of the DWA model. In this system the decision of prequalification is made through using decision rules and not calculated scores (Tran, 2002). This model's disadvantage is its implied treatment of unknowns imbedded in heuristic knowledge (Russell, Skibniewski, & Cozier, 1990).

Multi attribute analysis (MAA) can be implemented as a three stage model. It initially evaluates the general contractor attributes and then focuses on more specific criteria in its second stage. Then the result from these two stages combined with the third stage (bid price) is analyzed (Holt

& Olomolaiye 1994). Multi-attribute analysis fails to take into account the subjectivity of the input variables and does not incorporate systematic checks on the consistency of judgment (Holt & Olomolaiye, 1994; Belton, 1986). To improve this uncertainty, PERT (program evaluation and review technique) was used to develop a linear model for assessing the data which incorporates multiple ratings that reduce the uncertainty in data (Hatush & Skitmore, 1997). However this model still fails at handling the subjective nature of the process. Another problem inherited in this model is its lack of ability to grasp the non-linear relationship between a contractor's attribute and their corresponding prequalification decisions (El-Sawalhi et al. 2007). Use of a systematic multi criteria decision analysis technique allows different capabilities of the contractor to be evaluated. This model combines a simple scoring process and optimization models to deal with uncertainty in data (Hatush & Skitmore, 1998). The model is hard to work with as it requires exact probability values for the utility function and a very strong understanding of probability theory, which could make it impractical for many firms (Sonmez, Yang, & Holt, 2001).

Through evolution of these simpler models and to deal with their shortcomings, more complex and data intensive models were eventually created. The new models are based on more complex mathematical formulations and although they are not as user friendly as the previous models, they tend to provide better results. Fuzzy set models are a novel way to deal with uncertainty and the qualitative and quantitative nature of data. A fuzzy model resembles human reasoning and uses approximate information and uncertainty to derive a decision. However, it requires a strong mathematical background, which could explain why this is a favorite within the engineering community (Hatush & Skitmore, 1998). Similarly, artificial neural networks (ANN) can provide the basis for a complex and innovative prequalification model (Lam et al., 2000). An ANN is suitable for analysis of nonlinear relationship between the input and output variables. Its results can be generalized and are capable of making both calculations and interferences on a complex combination of the quantitative and qualitative data. Uncertainties and inaccuracies are reduced in this model; however, ANN are black boxes, with no clear way to understand the manner in which inputs are transformed into output. They are complex and require extensive data for training (Lam et al., 2000). Also, they require a large amount of historical data, which could be hard to collect (Tran, 2002).

In contrast to ANN and fuzzy set models, case based reasoning (CBR) is an artificial intelligence technology that uses existing solutions to solve new problems (Ng, 2001). CBR uses the stored experience from previous cases that match the specific inputs of the new case. Reasoning by reusing previous experiences is a common method for human problem solving. This allows derivation of a practical solution, even in a scenario where knowledge about a particular situation is weak. This is possible by modification of previous experiences to meet the condition of the new situation through the adaptation functions provided in the system. This system, unlike the new generation of prequalification models, is easier to use and does not need a strong mathematical background. This system however, requires a very large number of cases as an initial input and cannot adapt and predict new solutions (El-Sawalhi et al., 2007).

As seen in comparison of the existing models, the models are handicapped by their inability to deal with lack of objectivity and transparency. The models that were developed with the goal of overcoming these obstacles were either overly complicated or they required a significant amount of historical data which may not be available at all times. Hence, it is important that the developed model is able to deal with these issues and be as transparent, objective and user-friendly as possible.

1.4 Previous Research in this Series

In a report to OCS (Bedford, 2009), the following conclusions were made:

- cost escalation increases as the gap between the median and low bid increases
- prequalification is correlated with lower cost escalations
- projects with more bidders were prone to greater cost escalation

This papers aims at following up with the findings in that research by examining where prequalification was used and how effective it was. Also different practices of the owners that resulted in a better prequalification process are examined and compared with other public owners.

Chapter 2
Objectives and Methods

2 Objectives and Method

2.1 Objectives

The objectives of this research are:

1. Determine the best practices for public procurement of construction services with respect to tendering and award processes in Ontario.
2. Identify how prequalification improves a project (e.g. schedule, cost and risk).
3. Determine if there are feasible ways in which public procurement of construction could be improved

2.2 Method

This research depended heavily on the participation of public owners, general contractors, and sub-contractors to gather data. The Ontario Construction Secretariat (OCS) kindly assisted by inviting their membership to participate.

2.2.1 --- Data Collection

Data were collected from owners, contractors, subcontractors, and consultants. Data were collected from public owners by personal survey and from owners, contractors and subcontractors by two different on-line surveys.

1. Personal Survey. The survey is provided in Appendix A. The author conducted the 30-40 minute interview in person or by phone.

2. Online survey tool called “Survey Monkey”. Survey Monkey is a website through which the users can prepare a survey according to their needs. Participants then visit the website and complete the survey. The surveys are provided in Appendix B and C.

Most of the municipalities in Southern Ontario were contacted and invited to participate in the study. Nine responded positively. Interviews were conducted to determine their tendering practices using the questionnaire in Appendix A. The personal survey was also extended to the

three public owners in the Bedford (2009) study. To determine the specifics of their prequalification process, sample prequalification documents were requested. This standardized questionnaire inquired about the use of prequalification in the procurement process, how the process is implemented, categories used for this process and its benefits, restrictions and drawbacks.

Table 3: Public Owner Participation

Municipality	Interviewed	Use prequalification	Provided Documents	Participated in Online Survey
Municipality 1	X	X	X	X
Municipality 2	X	X	X	X
Municipality 3	X	X	X	
Municipality 4	X	X	X	X
Municipality 5	X	X	X	
Municipality 6	X	X	X	X
Municipality 7	X	X	X	X
Municipality 8	X	X		
Municipality 9	X	X		
Federal Owner A	X			X
Institutional Owner B	X	X	X	X
Institutional Owner C	X	X	X	X

Next, contractors who worked with these municipalities were surveyed using Survey Monkey. For this survey a number of contractors and consultants were contacted and of those, 5 contractors participated in the survey. Some of the responding consultants indicated that they had never worked on a project with a prequalified contractor nor they have never been involved directly with a prequalification process. The second online survey aimed at acquiring the point of view of owners, general contractors and sub-contractors. Of the contacted individuals, 8 public owners, 9 general contractors and 4 sub-contractors participated in the survey. Survey participants were provided with a list of criteria and practices and were asked to assign a rank of 1-5, with:

- 1 means very ineffective
- 2 means ineffective

- 3 means neither effective nor ineffective
- 4 means effective, and,
- 5 means very effective.

2.3 Analysis Methods

The data acquired in the three surveys were analyzed visually through comparison of different sections. However, for the online survey of owners, general contractors and sub-contractors analysis of variance was performed to determine the difference in opinion of these three groups. Analysis of variance (ANOVA) allows for comparison of two or groups to determine if any differences exist between the means of the populations (Mendehall et al., 2009). ANOVA allows for testing of many populations simultaneously without inflating the chances of error. As each individual test is subject to a percent error, performing pair wise comparisons would inflate the error and lower the confidence in which the values are significant (Mendehall et al., 2009).

Performing an ANOVA on the data can only show that there is a difference among the population means, however, an ANOVA does not specify which groups differ from one another. To analyze where the differences lay, Tukey's method for paired comparisons was employed. The importance of Tukey's method is that erroneously declaring statistical significance is minimized and equal to the confidence level desired. Tukey's method uses the highest and lowest sample differences as the determining aspect between all other pairs of populations (Mendehall et al., 2009).

To perform ANOVA and Tukey's statistical analysis, Minitab 16 computer software allowed for manipulation and analysis of large quantities of data rapidly. All of the Minitab printouts in the results denote A, B, C as owners, contractors and subcontractors respectively.

Three values are important in assessing the validity of these tests:

- Level of confidence or α (alpha). This value is often set at 0.05, which means that there is only a 5% likelihood that the observed phenomenon occurred by chance. In other words, you are 95% confident that the observed phenomenon is true. The lower the α, the more stringent the test. The desired level of confidence is determined in advance and is an input to the analysis. Throughout this study, $\alpha=0.05$.

- p-value or probability value. This value is an output of the analysis, and expresses the strength of the analysis. If $p < \alpha$ (that is to say, p is less than 0.05), then the null hypothesis is rejected, and the testing hypothesis is supported. This will be the primary means of determining statistical significance in this study. It is noted that a hypothesis can never be proven true using statistical analysis; it can only be proven false by the instantiation of one contradicting case.
- Fisher statistic or F-statistic. This value is used to calculate the p-value. It can be compared at the degree of freedom associated with the error to the tabulated value obtained from the Fisher table. If F statistic surpasses the tabulated value then the hypothesis suggests statistical significance at the appropriate level of confidence (alpha).

To understand and analyze Tukey's method, one must compare in the analysis the lower, center and upper columns in regards to each population being compared. For example, in comparing A to B, the minitab printout would show 'A subtracted from B' if all the numbers (lower, center, upper) are positive or negative, meaning the interval does not contain a zero. In this case, the two populations are judged to be significantly different from one another at the given alpha.

Figure 1 displays a summary of analysis methods used in this research and the resulting outcomes. In this figure, O denotes owners, GC denotes general contractors, and SC denotes subcontractors.

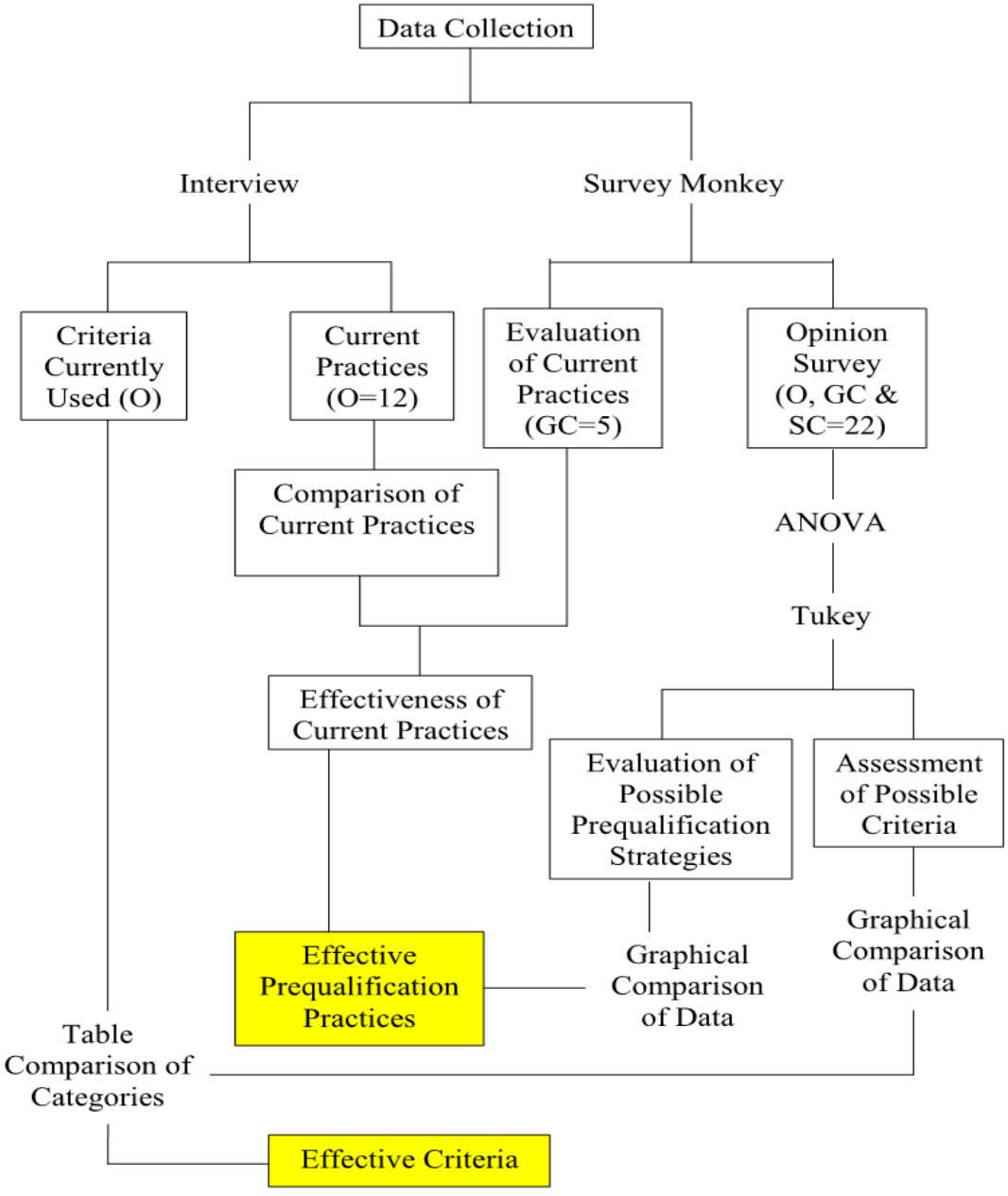

Figure 1: Analysis Procedure

2.4 AHP

Analytic Hierarchy Process (AHP) is used by the government, business, industry, healthcare and education sector as an effective tool in group decision making process (Saaty & Peniwati, 2008). AHP is especially helpful in situations where the ranking of alternatives is required (Forman & Gass, 2001). AHP helps in quantification of relative priorities for a given set of alternative priorities based on the judgment of the decision maker/s as well as the consistency of comparison of alternatives in the process. AHP has the capability to organize the tangible and intangible factors systematically and provide a simple solution to a complex decision making problem (Al-Harabi, 2001). This process also accommodates instances where group decision making is required and this allows for a more complete representation and understanding of the issues (Al-Harabi, 2001).

AHP is a systematic procedure for dealing with decision making problems with many alternatives. AHP is based on a hierarchical structuring of decision making elements using pairwise comparisons. As presented in Table 4, the decision maker compares two alternatives Ai and Aj with respect to a criterion and assigns them a relative score. This assigned value could range from 1 to 9 with 1 showing both criteria are equal and 9 showing that one category is significantly superior to the other.

This technique is fairly simple, practical, and can be performed using the following steps (Saaty, 2008):

1. Set up a hierarchy based on the goal and determine the alternative methods of reaching the goal and the evaluation criteria. The criteria can be further broken down into further sub-criteria based on the required depth of the problem.

2. Using pairwise comparison, determine a ranking amongst the elements of the model. These pairwise comparisons drive a numerical scale of measurements for each segment of the process. This process allows assignment of a weight to each section for establishment of an objective and numerical method of assessment for each

criterion. A scale of 1-9 is recommended to assign judgment in comparing the pairs of alternatives in each level of the hierarchy.

- 1 equal importance
- 5 essential or strong importance
- 9 extremely important

The reciprocal of these non-zero numbers are used when elements are compared in reverse. The matrix is normalized through division of each entry in each column by the sum of the entries in that column. By dividing the sum of each row by the number of entries in that row, a priority vector is achieved.

3. Combine these rankings to create a set of priorities for the model. These priorities are numbers associated with the nodes of this model and represent the relative weights of the nodes in any group. They are distributed amongst the model based on the way the hierarchy is setup and their values depend on the information entered by users of the process. They should add up to 1 in the higher stage of the hierarchy.

4. Check the model for consistency by calculating a consistency index CI. First, multiplying the priority vector by the original matrix. Then compute the row totals of the new matrix and divide each row total in the column by the corresponding entry from the priority vector and average the outcome to acquire the principle eigenvalue. $CI = (\lambda_{max} - n) / (n - 1)$, where n is the matrix size and λ_{max} is the acquired eigenvalue. If the CI does not exceed 0.10, then the matrix could be deemed consistent.

5. Make the final decision.

Table 4: Pair Wise Comparison Matrix

Contractor	A1	A2	…	An
A1	1	A12	…	A1n
A2	1/A12	1	…	A2n
⋮	⋮	⋮	⋮	⋮
An	1/A1n	1/A2n	…	1

Chapter 3
Discussion of Findings

3 Discussion of Findings

The results of the surveys focused on the prequalification process and criteria. Evaluation of the prequalification process includes its benefits, limitations, efficiency, and prequalification of sub-contractors, consultants and designers. Prequalification criteria are compared to the literature for benchmarking purposes. Finally, the viewpoints of owners, general contractors and sub-contractors are compared and significant differences discussed.

3.1 Prequalification Evaluation

All of the participating municipalities use prequalification somewhere in their procurement process; however, they differ in frequency and process. Table 5 shows the prequalification practices of these municipalities alongside the perceived benefits, drawbacks and limitations of the process.

Table 5: Prequalification Practices of Public Owners

	Municipality 1	**Municipality 2**	**Municipality 3**	**Municipality 4**	**Municipality 5**	**Municipality 6**	**Municipality 7**	**Municipality 8**	**Municipality 9**	**Inst. Owner B**	**Inst. Owner C**
Implementation of the system											
Process implemented by internal review	X	X	X	X	X	X	X	X	X	X	X
Criteria selected based on industry best practices		X		X	X	X	X	X		X	X
Criteria selected based on internal review	X		X	X	X	X			X	X	
Criteria selected based on experience of workers			X	X					X	X	X
Criteria selected in consultation with other public buyers	X			X	X						
Process implemented as a common industry practice					X				X		
Criteria selected in consultation with											

	Municipality 1	Municipality 2	Municipality 3	Municipality 4	Municipality 5	Municipality 6	Municipality 7	Municipality 8	Municipality 9	Inst. Owner B	Inst. Owner C
contractors											
Requirements											
Prequalification performed on a project-by-project basis		X	X	X	X	X	X	X	X	X	
Prequalification documents submitted in paper format		X	X	X	X	X	X	X	X	X	
Criteria are project dependent	X	X	X		X	X	X	X		X	
Contractor can become disqualified	X		X			X	X	X		X	X
Prequalification performed for a pool of projects	X	X				X		X		X	X
Prequalification required for sub-contractors		X	X	X	X	X					X
Prequalification required for consultants/ designers	X			X		X		X		X	
Show scoring criteria	X		X		X	X					
Prequalification documents submitted electronically	X										X
Benefits, Limitations and Shortcomings											
Prequalification is viewed as time consuming	X	X	X	X	X	X	X		X	X	X
Prequalification ensures capable firms are bidding on the project	X		X	X	X	X	X		X	X	
Prequalification is viewed as resource consuming		X	X		X		X	X			
Creates obstacles for entry of new contractors		X	X			X	X	X			
Prequalification reduces risk		X					X		X		X
Prequalification requires long term planning	X			X					X		
Prequalification reduces workload for bid calls	X		X					X			
Prequalification ensures due diligence is performed		X	X								
Prequalification is time saving in nature			X							X	

	Municipality 1	Municipality 2	Municipality 3	Municipality 4	Municipality 5	Municipality 6	Municipality 7	Municipality 8	Municipality 9	Inst. Owner B	Inst. Owner C
Prequalification narrows the competitive field				X				X			
Prequalification creates transparency issues					X					X	
Prequalification does not allow engagement of clients and owners							X				
Prequalification is restrictive by nature of work	X										

Error! Not a valid bookmark self-reference. exhibits the opinions of the participants about the effectiveness of various prequalification practices. ANOVA analysis (p= 0.211) suggests no significant differences in the way that participants (owners vs. general contractors vs. subcontractors) view prequalification in general. However, differences exist when criteria are considered individually.

3.1.1 --- Benefits of Prequalification

While owners, general contractors and sub-contractors all recognize that prequalification allows owners to reduce their risk, general contractors and sub-contractors believed this more strongly than owners. Contractors also acknowledged a benefit to themselves as prequalification reduces the number of unqualified bidders, allowing qualified bidders to become more competitive. This is supported by Bedford (2009), who observed that the owner without a prequalification process had higher cost escalation than those who had one. The same trend was observed on smaller projects where prequalification was not applied (Bedford 2009).

The participants also recognized that implementation of a prequalification process may result in a better quality project. Contractors believed that this increase in quality could be due to better communication between the contractor, owner and the consultants because the contractor's qualifications are clearly established and owners tend to have better respect for them. This increased level of trust allows for better cooperation. The participants also indicated that projects

that involve prequalification have a better safety record. However as effective as increased communication could be, it cannot replace bid bonds as an essential part of prequalification.

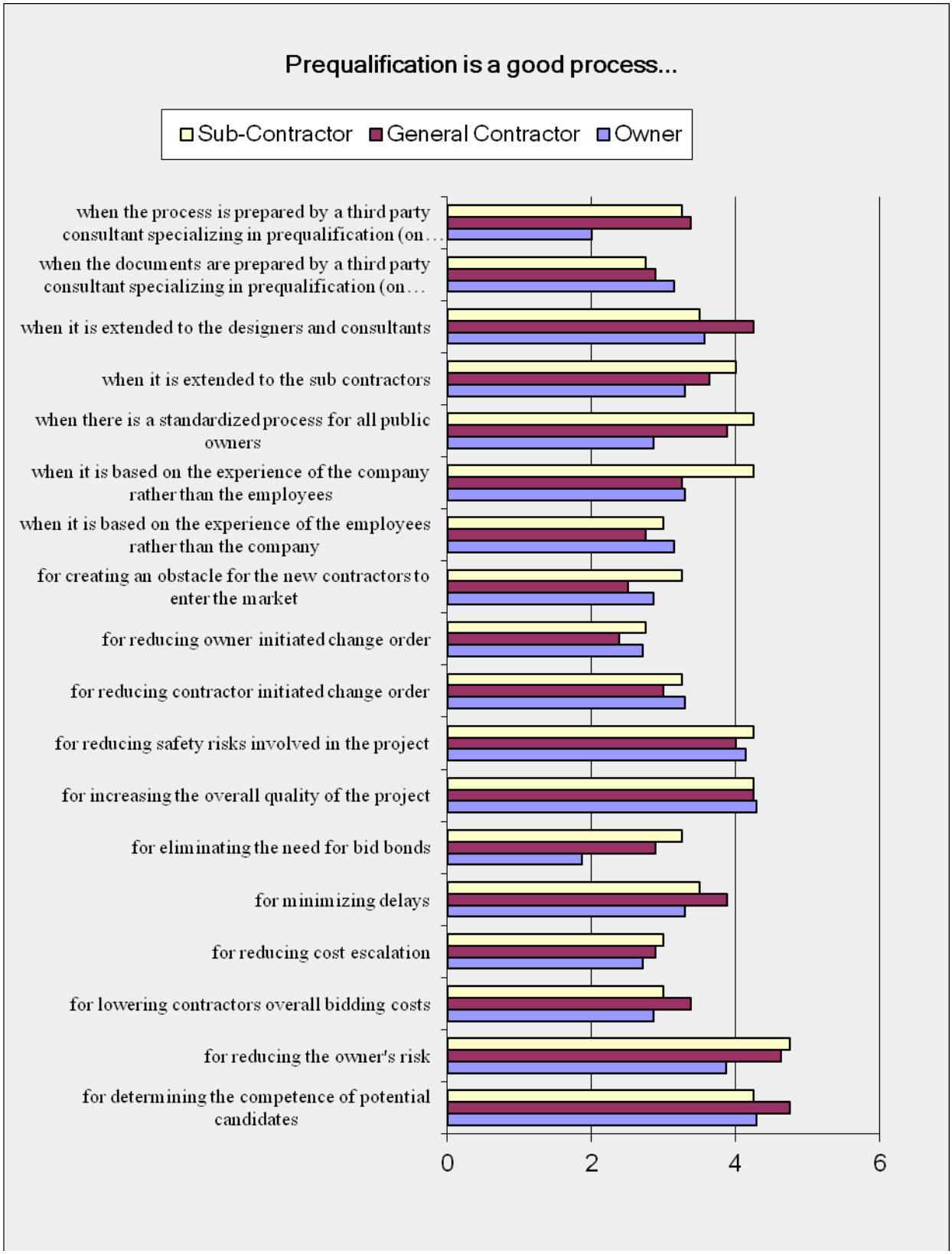

Figure 2: Evaluation of Prequalification Process

3.1.2 --- Issues Involving Prequalification

One of the main issues with prequalification is the commitment of time and resources that isn't justified by the potential savings. Many of the municipalities also thought that prequalification may create an obstacle for new contractors. However, they also recognized that prequalification aims to find more experienced and qualified contractors - newer contractors can gain the necessary experience on smaller projects that do not require prequalification.

Due to its subjective nature, prequalification may lack transparency. Contractors felt that revealing the evaluation criteria and scoring system allows them to focus their submissions on factors that are most important to the owner. Public owners may also review their decisions with the contractors to address their concerns and allow contractors to be better prepared for future rounds.

3.1.3 --- Efficiency of the Process

Participating municipalities commonly prequalify contractors on a project-by-project basis, a practice that was ranked very effective by contractors. However this practice is cost and resource intensive.

Bedford (2009) found that projects that do not have a prequalification process have higher cost escalations. Contractors indicated that there should be a lower limit on project size for prequalification to be undertaken. Along with controlling costs, this would also allow inexperienced contractors to gain experience on smaller projects.

Municipality 1's (M1) prequalification practices were ranked very effective by the participating contractors. M1 prequalifies contractors for a pool of projects. This is contrary to previous opinions that it is more effective to prequalify on a project basis. On closer examination, it was found that M1 prequalifies contractors for groups of projects that are similar in nature and constructed within a certain time period (1-3 years), allowing them to ask project-specific questions tailored to the needs of the projects and allowing contractors to prequalify for more than one project with a single submission.

Best Practice 1:
Municipalities can achieve a better value by prequalifying contractors on a group of projects.

Disqualification clauses are important – they give the municipality the right to modify a contractor's qualification status if the contractor performs poorly during the "qualified" period.

Only two owners use an online system to collect prequalification documents, allowing the owners to save paper and storage costs. Efficiency could be further enhanced if a uniform and standardized prequalification process was used by all municipalities. For contractors, a standardized process would require them to be familiar with only one set of prequalification documents, allowing them to save time preparing their submissions. They would be able to provide clearer and more concise answers to the questions, which could also make the evaluation process easier for the owner. Owners would also benefit by a reduction in document preparation time, as the standardized documents would require only minor modification. Contractors said that the owners with the better prequalification practices were Municipalities 1, 2, 3 and 6. These municipalities have very similar practices (Table 5) and criteria (Table 6). Three out 4 use CCDC 11; those that don't, use similar criteria.

Best Practice 2:
Using electronic documents is an effective method of increasing the efficiency of the process.

Best Practice 3:
Using standardized documents is an effective method of increasing the efficiency of the process.

Bedford (2009) revealed that Owner C not only uses significantly fewer criteria than Owner B (CCDC document 11 plus additional criteria) but also experiences less cost escalation. This brings to question the benefit of acquiring the additional information for Owner B. Some researchers hypothesized that this would increase the cost effectiveness of applying for prequalification for the contractor, without taking away from the benefits of prequalification (Ng & Skitmore 2001).

Best Practice 4:
Using a select number of high value added questions has the potential to increase the efficiency of the prequalification process

3.1.4 --- Prequalification of Subcontractors, Consultants and Designers

Prequalification of designers, consultants and subcontractors was not ranked effective by the owners (**Error! Not a valid bookmark self-reference.**) and is not common practice. The few owners who use this process mentioned that it is only done for a few projects. For example, Owner C prequalifies subcontractors when their work represents a large portion of the project budget, or when the work is very complex (Bedford 2009). However, this process was considered very effective by the general contractors and subcontractors because contractors feel that poor design leads to cost escalation, delays, and conflict.

Best Practice 5:
Prequalification of subcontractors, consultants and designers ensures competent trades and designers are participating in the project.

3.2 Prequalification Criteria

Table 6 shows the selection criteria used by different municipalities.

Table 6: Public Owners' Prequalification Criteria

	M1	M2	M3	M4	M5	M6	M7	I.O.B	I.O.C
1. CCDC Document 11	X	X	X	X	X				X
a. Bonding verification	X	X	X	X	X	X	X	X	X
b. Principal projects completed in last five yrs	X	X	X	X	X				X
c. Banking information	X	X	X	X	X			X	X
d. Description of related projects	X	X	X	X	X	X	X	X	X
e. Current workload	X	X	X	X	X			X	X
f. Company Organization	X	X	X	X	X				X
g. Annual value of construction in past 5 years	X	X	X	X	X				X
h. List of key office personnel	X	X	X	X	X	X			
i. List of key site personnel	X	X	X	X	X	X			
2. Insurance verification	X	X	X	X	X	X		X	X
3. Company's health and safety policy	X	X	X		X	X	X	X	X
4. Project team/ curriculum vitae	X	X	X	X	X	X		X	X
5. WSIB Clearance certificate	X	X	X			X		X	X
6. Experience of key staff	X				X	X	X	X	
7. Reference from the owner			X		X	X	X		
8. Samples of construction schedule for comparable projects	X		X			X			
9. Project management/ control policy	X					X	X		
10. Scheduling information	X			X			X		
11. Contractor should be signatory to the trade	X					X		X	
12. CAD-7 Experience rating	X				X			X	
13. Sustainable practices		X			X				
14. Authorization to acquire financial information			X		X				
15. Financial Stress Score report		X							X

	M1	M2	M3	M4	M5	M6	M7	I.O.B	I.O.C
16. Available Equipment					X			X	
17. Health and Safety		X				X			
18. Tender cost of related projects			X						
19. Schedule for previous projects	X					X			
20. Identify disciplines managed in previous project						X		X	
21. Identify projects specifically related to the project						X		X	
22. Identify repeat clients			X						
23. Existence of any liens/ legal disputes	X								
24. Previous non-compliance within past 5 years								X	
25. Credit Rating								X	
26. Qualification of the team		X							
27. Understanding of the project		X							
28. Final construction cost of related projects			X						
29. Available licenses								X	
30. Method of project delivery			X						
31. Methodology and innovation				X					
32. Proof of asbestos training								X	
33. Verification that company has delivered 3 public contracts within the last 7 years	X								
34. Technical Expertise		X							
35. Police reference check								X	
36. Proof of union affiliation								X	

Municipalities share many common criteria. Since many of the municipalities are part of the Ontario Public Buyer Association (OPBA), their practices can be influenced by other municipalities. However, there exist some differences across municipalities and other public owners. For example Owner B indicated that they require a police reference check as a part of their prequalification package due to the nature of their work, which makes their liability insurance costs higher and requires them to take additional steps to prevent future incidents.

3.2.1 --- Category Ranking and Most Used Criteria

Table 7: General Category Ranking

General Category	Rank		
	Literature	Current Practices	Online Survey
Financial stability	1	2	2
Experience, past performance	2	5	1
Company organization	3	3	7
Health and safety	4	4	6
Capacity of the Contractor	5	7	3
Management capabilities	6	1	5
Project control procedures	7	6	3
Geographic location	8	8	8

Table 7 compares the ranking of general categories between the literature and our two surveys. Similar to the literature review, industry experts in the region believe that financial stability, experience, and past performance are the two best indicators of contractor qualification. Financial stability is one of the most important categories in determining a contractor's qualifications and geographic location is ranked last by all three rankings. Health and safety ranks fourth, similar to the literature. Although health and safety is not the most important category, it is always important enough to be present. Public owners focus on health and safety and similar issues that aim at reducing their liability i.e. insurance verification due to regulatory and transparency constraints imposed on public owners.

3.2.2 --- Scoring Criteria

Table 8 shows the weights that four municipalities assign to their selection criteria. The categories marked M mean that they are mandatory. Interestingly, financial stability is not highly stressed as previously indicated and bonding seems to be adequate. This is contrary to some of the findings in the literature where financial stability makes up a significant portion of the scoring criteria (Russell & Skitbniewski, 1990). Most of the focus is placed on experience, past performance, and management capabilities. This is in line with the findings in the previous sections and the reviewed literature. Existing papers and models assign a significant portion of the score to experience and past performance, which allows them to study the practices of the

contractor (Russell & Skbniewski, 1990; Ng & Skitmore, 2001). This added transparency is important for the contractors as they can put less focus on the unimportant criteria and put their effort on criteria that play a significant role in the selection process.

Table 8: Criteria Evaluation

	M1	M2	M3	M5
Financial Stability				
Financial status requirement			20	
Bonding	M	M	M	M
Insurance	M			
Experience and Past Performance				
Company Experience	21			
Reference checks			20	
Related project experience	21	24	20	
Work experience				10
Key experience and resources				30
Experience in specific work		24		
Capacity of the Firm				
Proponent's plan and understanding of the project			10	
Project Control Procedures				
Project management/control		8		
Employee training				60
Scheduling	21			
Commitment to schedule and schedule templates provided			10	
Health and Safety				
Health and Safety	16	20		
CAD-7 and WSIB documents	M			
Management Capabilities				
Experience of key personnel to be assigned to this project	21	24	15	
Company Organization				
In business for more than 10 years	M			
Completeness of submission	M		5	

3.3 Criteria Evaluation

Criteria are reviewed next and their importance to each participant group compared. As noted in the Methods section, the level of significance is 5%. If $p<0.05$, then the results are considered statistically significant. Criteria that are rated by owners, general contractors, and subcontractors as effective or very effective (≥ 4.0) are highlighted as *Effective Criteria*.

3.3.1 --- Financial Stability

The factors included in this category are shown in Figure 3. As $p>0.05$, no significant differences are observed. All three parties agree on the significance of determining financial stability. However, sub-contractors rank some criteria slightly higher. This is due to their reliance on the financial ability of the general contractors for getting paid.

3.3.2 --- Experience and Past Performance

The factors included in this category are shown in Figure 4. As $p>0.05$ there does not exist significant differences between the opinions of the participants. Disputes (mediation, arbitration, and litigation) are difficult as a measure because the details are a function of the viewpoint of the party. Therefore, this category does not take into account who was at fault.

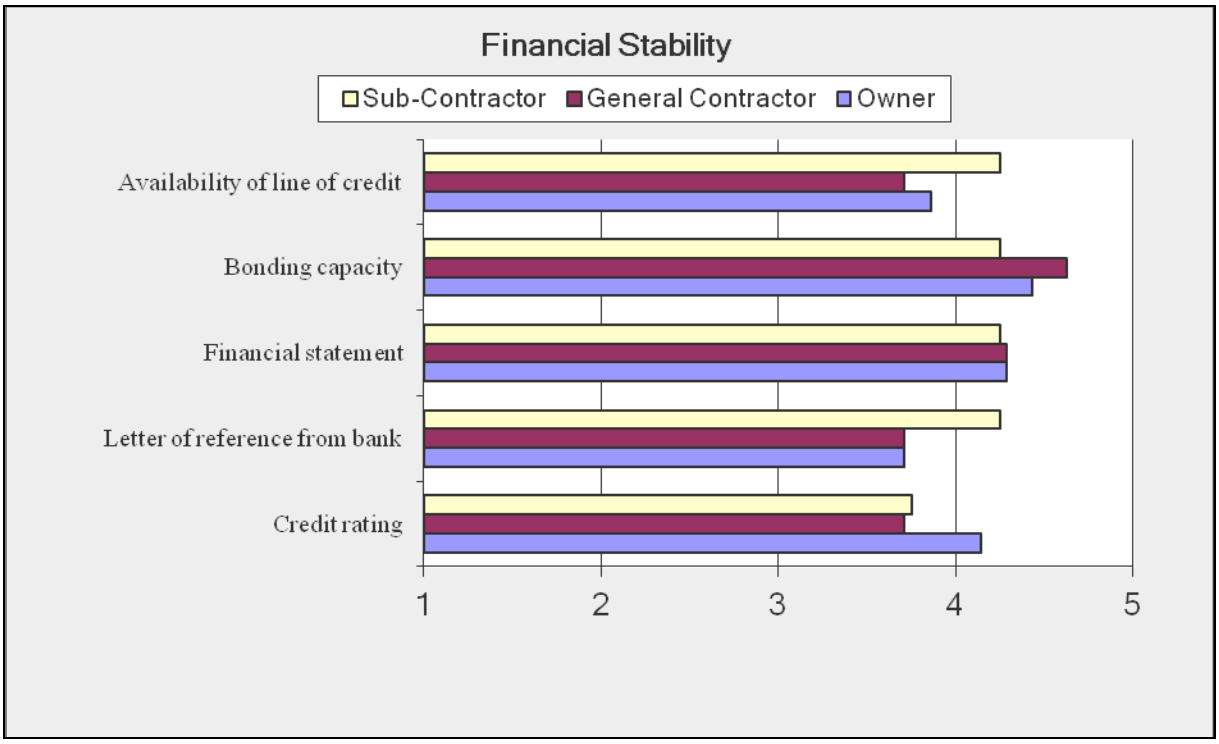

Figure 3: Financial Stability (p=0.233)

Effective Criteria:
1. Bonding Capacity
2. Financial Statement

Owners and subcontractors believe more strongly than general contractors that schedule and cost overruns are good indicators of contractor incompetence. Contractors (often rightfully) assign a portion of the responsibility for delays and cost overruns to the owner and designers; however, a good communication and collaboration strategy by the general contractor can reduce overruns and the associated finger pointing. Finally, owners are less convinced that references from previous projects are a good method for measuring competence due to contractors' ability to provide only good references. Hence, a more thorough review of a contractor's previous projects is needed.

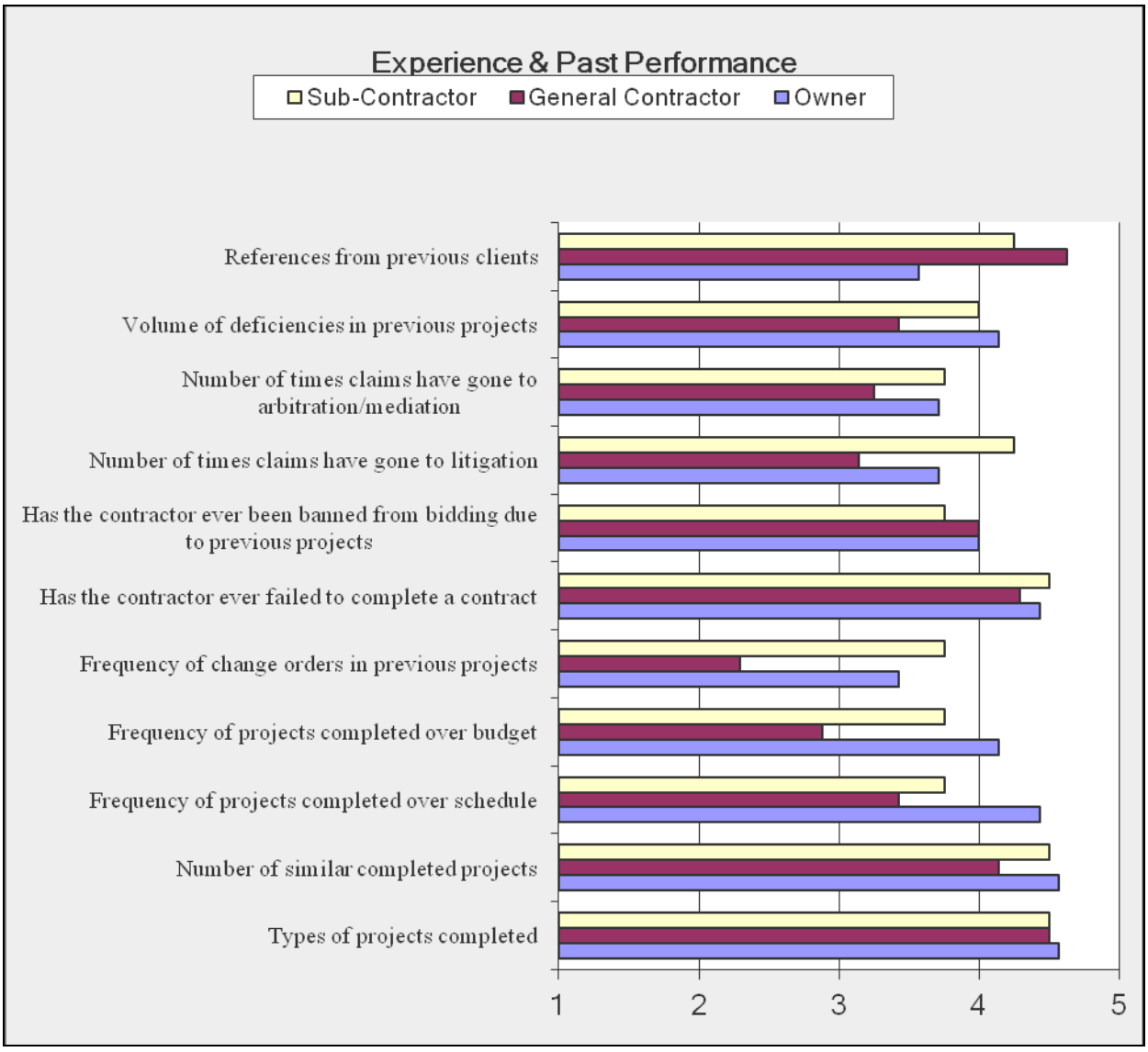

Figure 4: Experience and Past Performance (p= 0.211)

Effective Criteria:
3. Has the contractor ever failed to complete a contract
4. Number of similar completed projects
5. Types of projects completed

3.3.3 --- Project Control Procedures

The factors included in this category are shown in Figure 5. As $p<0.05$, there exist significant difference between the opinions of the participants. Tukey analysis revealed that this difference exists between the general contractors and the other two groups. Project control procedures are important for effective operations of a general contractor; however, subcontractors and owners

tend to be less involved and therefore rate them as less effective measures. This difference is more pronounced when the opinions of the sub-contractor and general contractors are compared. No project control related criteria were used extensively by owners, but they were one of the top ranking criterions in the literature. It is important to note that none of the factors fell below 3, indicating that all parties agree that they are effective to some degree.

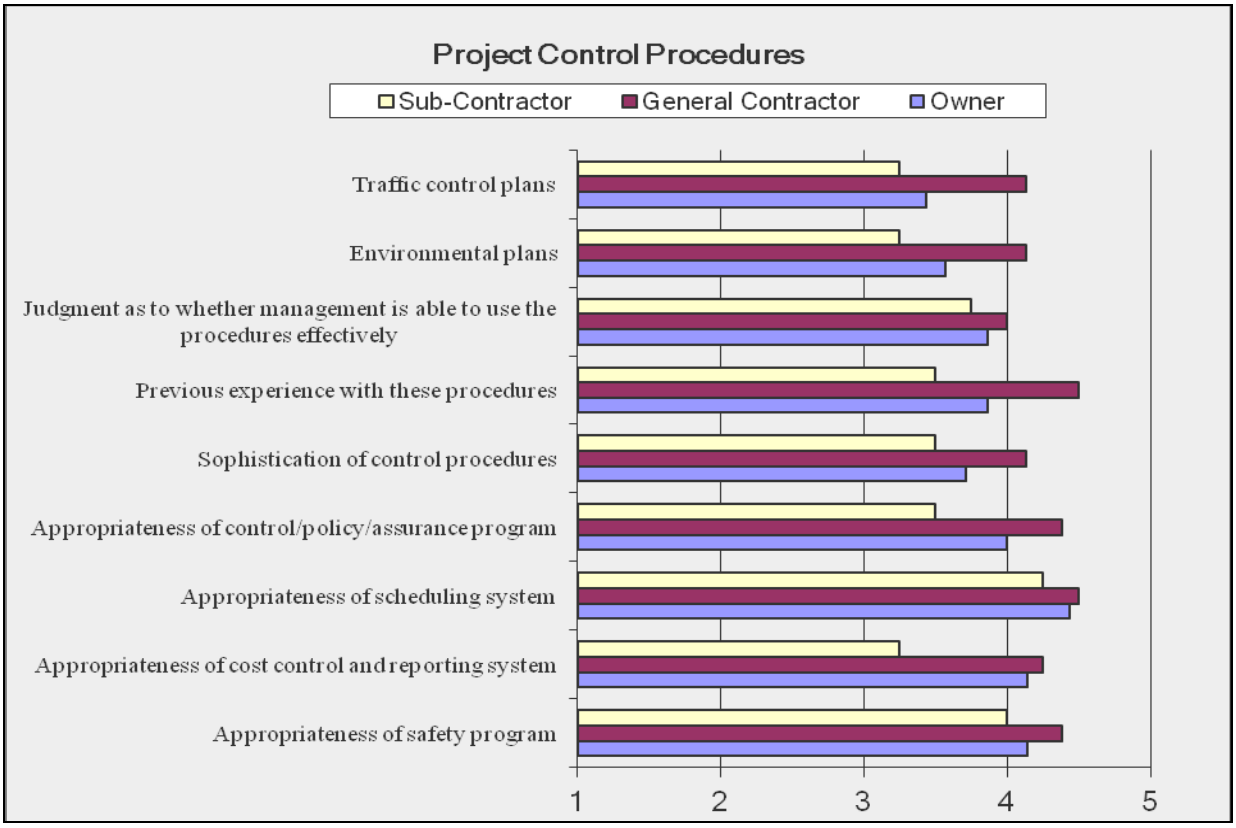

Figure 5: Project Control Procedures (p=0.00)

Effective Criteria:
6. Appropriateness of scheduling system
7. Appropriateness of safety program

3.3.4 --- Geographic Location

The factors included in this category are shown in Figure 6. As $p<0.05$, there exist significant difference between the opinions of the participants. The Tukey analysis revealed that this difference is between the sub-contractors and the general contractors. This category was not

strongly supported by any group as an effective measure of qualification. Overall, subcontractors were less supportive than owners and general contractors. Experience in the local area and with local labour was most strongly supported by general contractors.

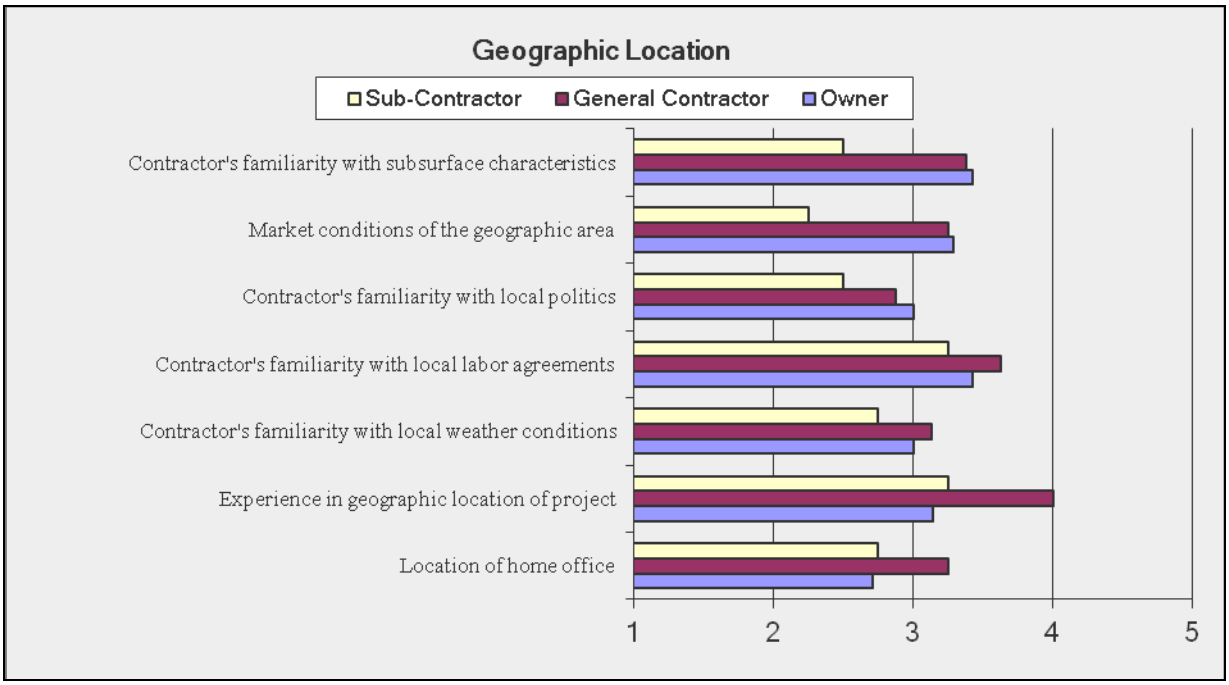

Figure 6: Geographic Location (p=0.00)

3.3.5 --- Health and Safety

No significant differences exist between the three participant groups ($p>0.05$); however, there is a practical difference with WSIB ratings (Figure 7). Subcontractors, unlike owners and general contractors, feel that WSIB ratings are ineffective at measuring the competence of a contractor. Because subcontractors provide most of the labor on site, their CAD-7 or MAP ratings are most impacted by accidents, particularly if they are small enterprises.

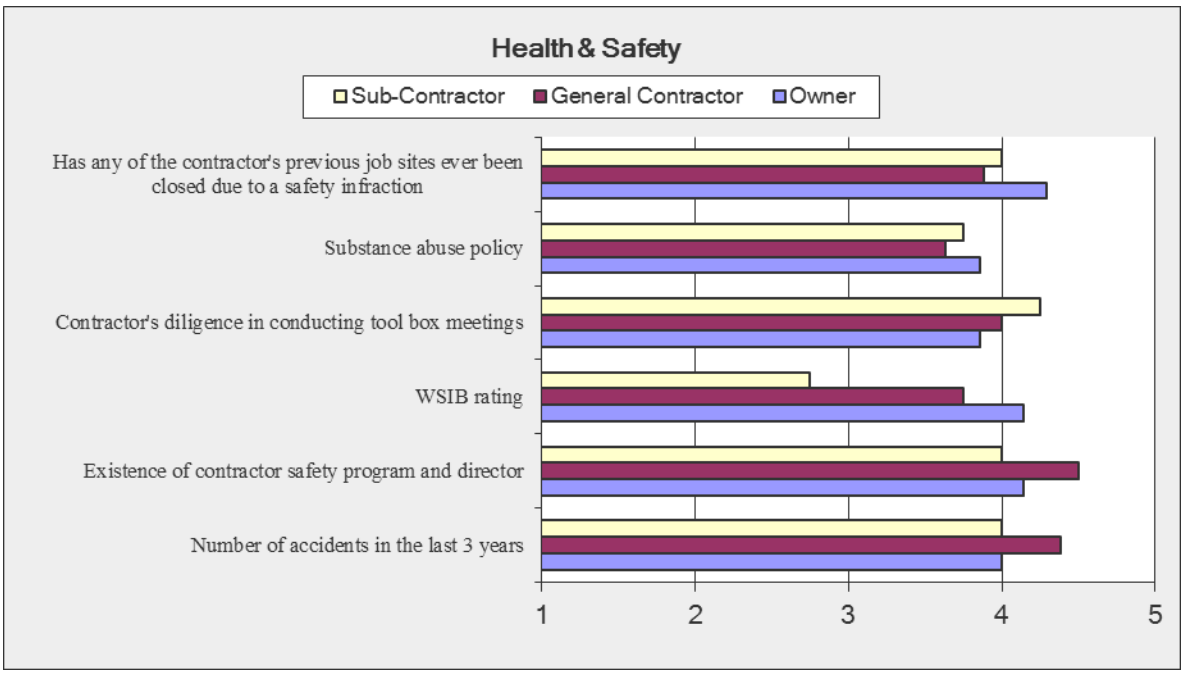

Figure 7: Health and Safety (p=0.456)

Effective Criteria:
8. Existence of contractor safety program and director
9. Number of accidents in the last 3 years

3.3.6 --- Management Capabilities

ANOVA analysis reveals that there exist significant differences between the opinions of the three groups as $p<0.05$. The criteria used in this category are shown in Figure 8. A Tukey analysis reveals that owners believe much more strongly than the contractors that schedule, cost, and deficiency performance of key personnel are effective indicators of qualification. Owners and subcontractors feel more strongly that the amount of work performed with an organization's own forces is a good criterion in prequalification although all groups scored this under 4. All three groups agreed that experience and qualifications of key personnel are effective measures.

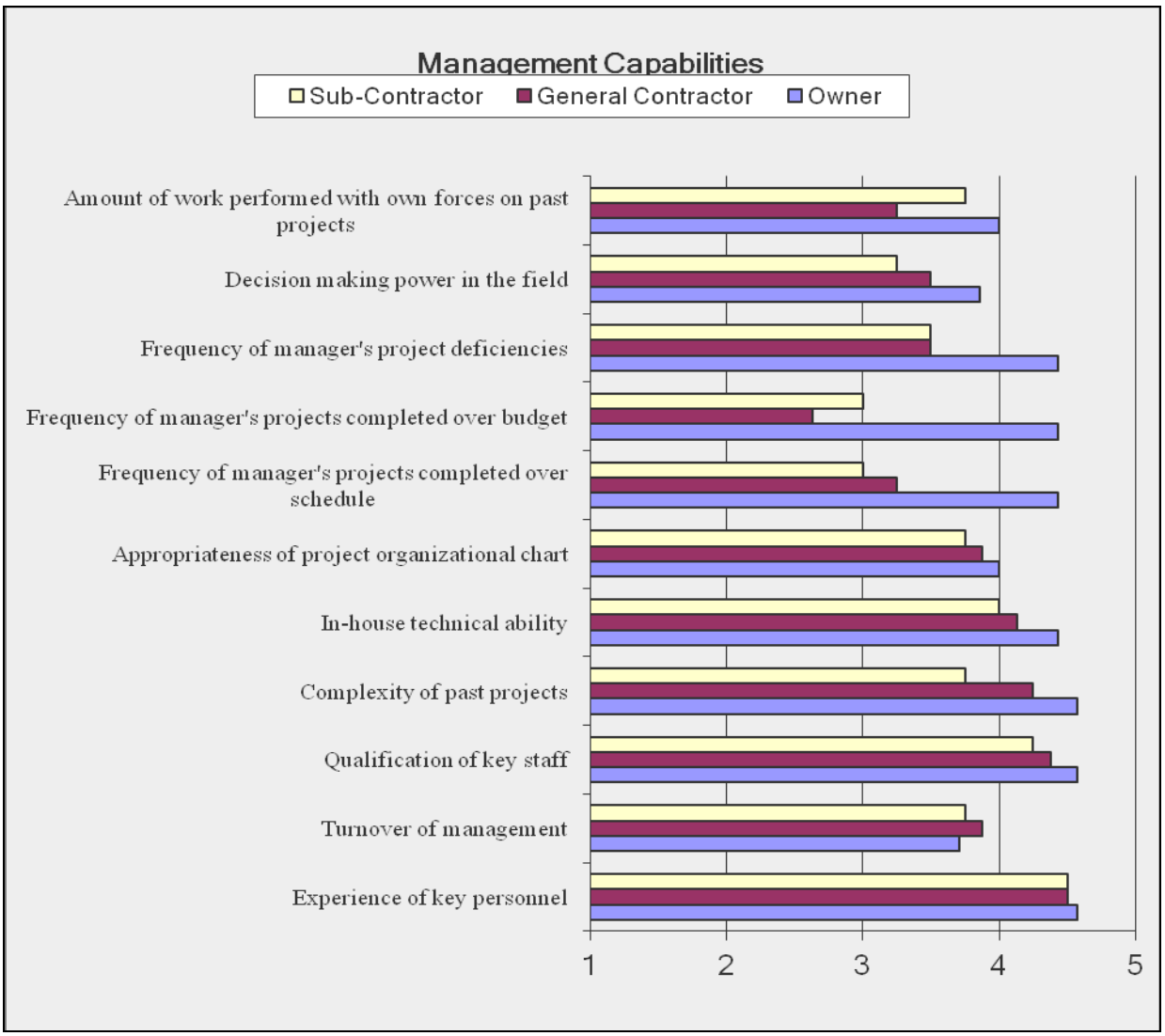

Figure 8: Management Capability (p=0.01)

Effective Criteria:
10. In-house technical ability
11. Qualification of key staff
12. Experience of key personnel

3.3.7 --- Company Organization

Figure 9 reveals no significant differences between the opinions of the three groups ($p>0.05$). Overall, they agreed that Years in construction, Licenses, and Failure to complete a contract are effective measures in prequalification.

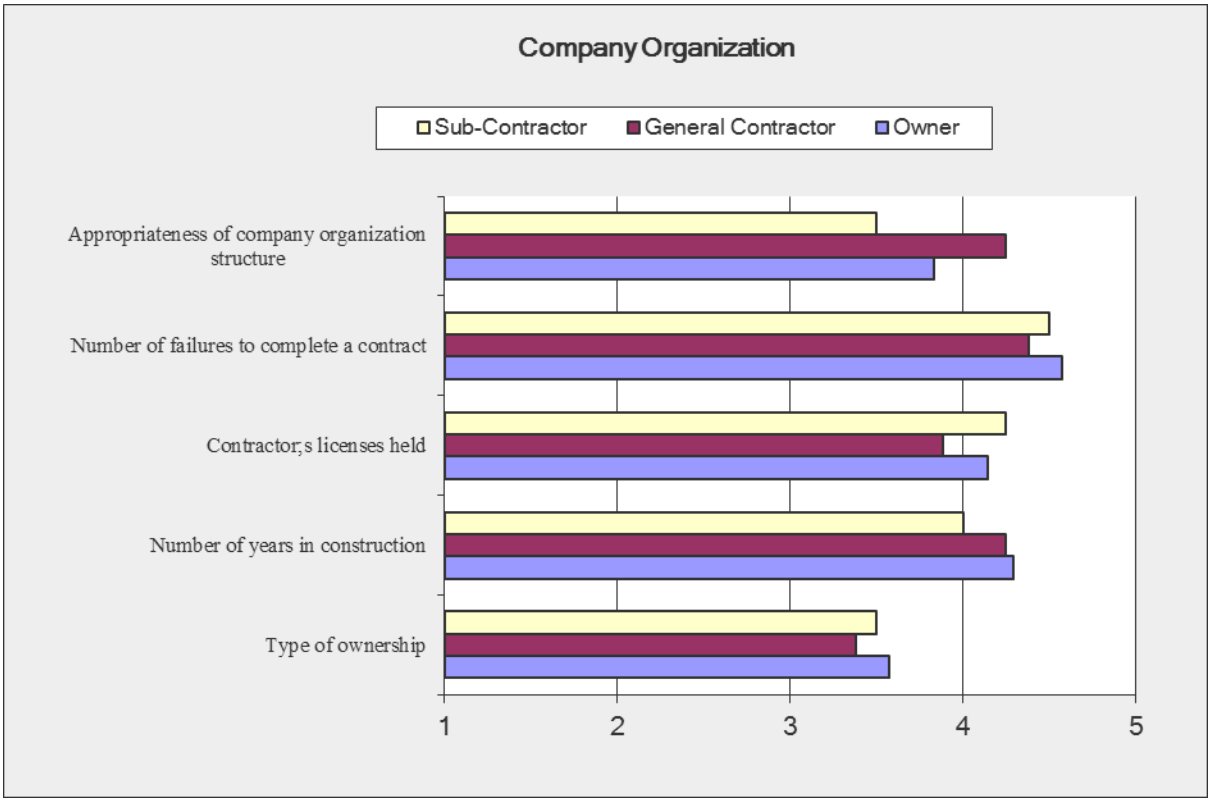

Figure 9: Company Organization (p=0.885)

Effective Criteria:
13. Number of failures to complete a contract
14. Number of years in construction

3.3.8 --- Capacity of Contractor

The factors included in this category are displayed in Figure 10. As $p<0.05$, significant differences exist between the three groups. Tukey analysis reveals that these differences are between the general contractors and owners. Overall, owners find this category more important than the contractors. This difference becomes more evident for criteria that aim at determining the qualification and availability of employees and equipments. Although contractors can rent equipment that is not readily available in their fleet, owners may perceive that owning and maintaining equipment is a measure of financial prowess, operational efficiency, and capacity.

Owners place a lot of emphasis on employee based factors, including training, turnover, experience, and access to engineers. The contractors agree at varying degrees, depending on the specific factor. For example, number of engineers hired by the contractor can be an effective method of determining the contractor's attitude towards innovation and towards acquiring more skilled employees. Although engineers and consultants can be hired as a third party, presence of a highly trained individual in staff allows for better quality control and planning on jobs, hence this criterion can be an effective method of determining contractor's practices.

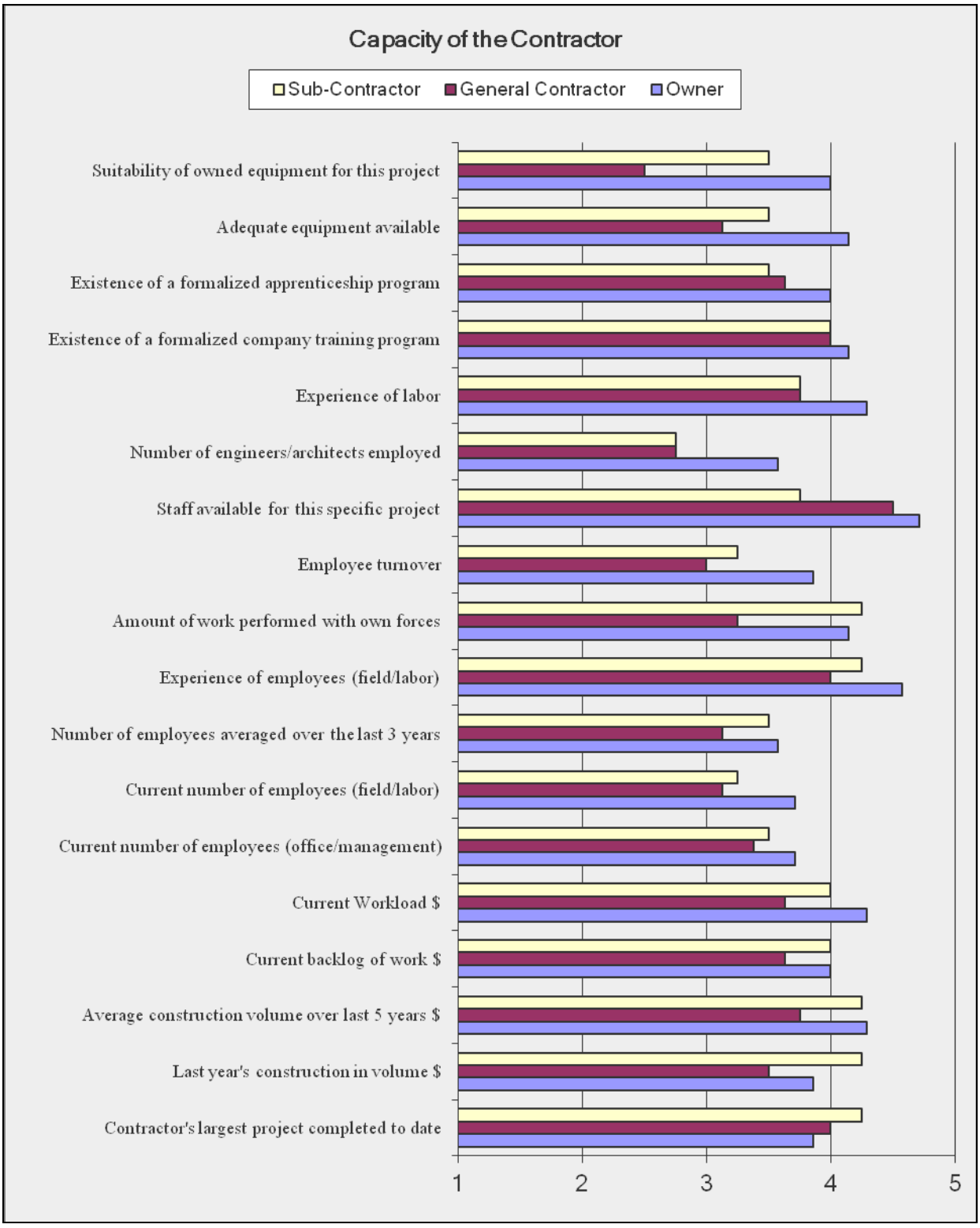

Figure 10: Capability of Contractor (p=0.001)

Effective Criteria:
15. Experience of employees (field/labor)
16. Contractor's largest project completed to date
17. Staff available or this specific project

3.4 Limitations

One of the limitations of this research was the lack of available data. This research heavily depended on the participation of public owners, general contractors and sub-contractors. Although an adequate sample was achieved, a larger sample that included non-union contractors would have been beneficial in providing a more broad analysis.

Chapter 4
Proposed Model

4 Proposed Model

4.1 Model Description

The results acquired during this research allows for the development of a prequalification implementation system that could be used at the concept stage of a project. This proposed system allows for a structured process that is aimed at determining whether prequalification is needed and then how it should be implemented. In this hierarchical model, displayed in Figure 11: General Implementation Process**Error! Reference source not found.**, the owner identifies some preliminary characteristics of the project i.e. project size and complexity, which will then determine the need for prequalification.

Subcontractor (SC) prequalification has the potential to significantly increase the quality of a project. However, since this process is also resource consuming, it is more effective to first determine if the prequalification of subcontractors would be beneficial. Sub-contractor prequalification should be done in parallel, but separate to general contractor prequalification.

If it is determined that prequalification (contractor and possibly sub-contractor) is in fact needed, then the owner is asked if similar projects are planned for the near future, in which case the similar projects can be grouped together and contractors can request to be prequalified for the group of projects. However, if no similar projects are identified for the next two years, then the prequalification model can be modified to allow for automatic prequalification of contractors who can prequalify for the existing project within the next 2 years. After the projects are grouped, the development of a prequalification process begins. The first step depends on creating a prequalification data bank, which stores prequalification information from public owners, which would allow others to see what criteria were used for the previous projects and how the process was implemented. If no previous projects are identifiable, the process could be initiated with a series of primary/secondary criteria as identified in Figure 11. Then the owner must identify if there are any specific criteria required for this group of projects. For example if these projects require knowledge and experience with a certain type of construction or tool, then the

process will ask for specific requirements to address those needs. Following this step, each of the assigned criteria should be assigned an appropriate weight based on the project needs.

To enhance the quality of the prequalification process and to avoid transparency issues, it is important to determine the decision criteria and their method of evaluation early on in the process. As discussed in the best practices covered in section 3.1Prequalification Evaluation, it is important to select only a few criteria that contribute a high added value. Although it is important to remain as objective as possible, some categories that bring a high added value can only be evaluated subjectively. To deal with issue, it is proposed that the owner create a hypothetical contractor, who just meets the absolute minimum of what is required to competently finish the project. Creation of this hypothetical contractor creates a threshold which the contractors applying for prequalification status can be compared against.

Figure 12: Typical Decision Criteria displays the typical/default criteria used. These criteria were selected based on the effective criteria identified in section 3.3. This model proposes a binary evaluation system based on 1 & 0 which aims at simplifying the evaluation step of the prequalification process. If the contractor's capability surpasses those of the hypothetical contractor then a passing grade of 1 is assigned. If the contractor does not meet the specified requirements, then a failing grade of 0 is assigned.

It is proposed that the owners use the default set of criteria for the evaluation process in their prequalification system. These criteria have been determined effective through an extensive survey previously disclosed in section 3.3. Some criteria are so significant that the contractors' lack of ability to meet them should automatically disqualify the contractor from the process. This set of criteria will be referred as "Primary Criteria (PC)" and a score of 0 on any of the criterion will result in full disqualification. The other set of criteria are not as critical and these criteria should evaluate in a different manner. These "Secondary Criteria (SC)" should be assigned a weight based on the AHP model previously recommended for this step. Through review of the findings in the survey, it was identified that although some difference exists in the level of importance assigned to each criteria, for evaluation purposes the difference is not significant enough. Hence, it is proposed that the model should weight these categories equally. After the

weighting has been assigned, the owner should also identify that what should be assigned as the passing score, which is dependent on the details of the project.

The qualification score for Contractor x can therefore be calculated as:

Equation 1: Score Evaluation

$$Score_k = \prod_{i=1}^{n} P_{ik} * \sum_{j=1}^{m} (S_{jk} * W_j)$$

Where:

$Score_k$ = prequalification score for contractor k

P_{ik} = primary criteria i score for contractor k

S_{jk} = secondary criteria j score for contractor k

W_j = weight assigned to secondary criteria j

As found in the best practices in section 3.1Prequalification Evaluation, using electronic resources in the prequalification process is an effective method of increasing the efficiency of the process. Hence it is proposed that the call for prequalification should be made through a secure website in addition to the mediums currently used. Currently a website called Bidingo provides the means for electronic call for prequalification and is being used by various municipalities interviewed in the process. The collection of the prequalification data should be also done through a secure data, which could be developed to store contractors' previous submissions. This allows municipalities to also cross reference submissions to the old submissions to review for any inconsistencies. Based on the centralized system, this would allow owners to exchange previous information based on contractor's performance that would allow the municipalities to decide on contractors qualification based on previous experience. This would also allow owners to also take away the contractor's automatic prequalification status based on performance on previous projects. After the submission has been verified, the submitted data can be evaluated and the prequalification status can be awarded to the qualifying contractors.

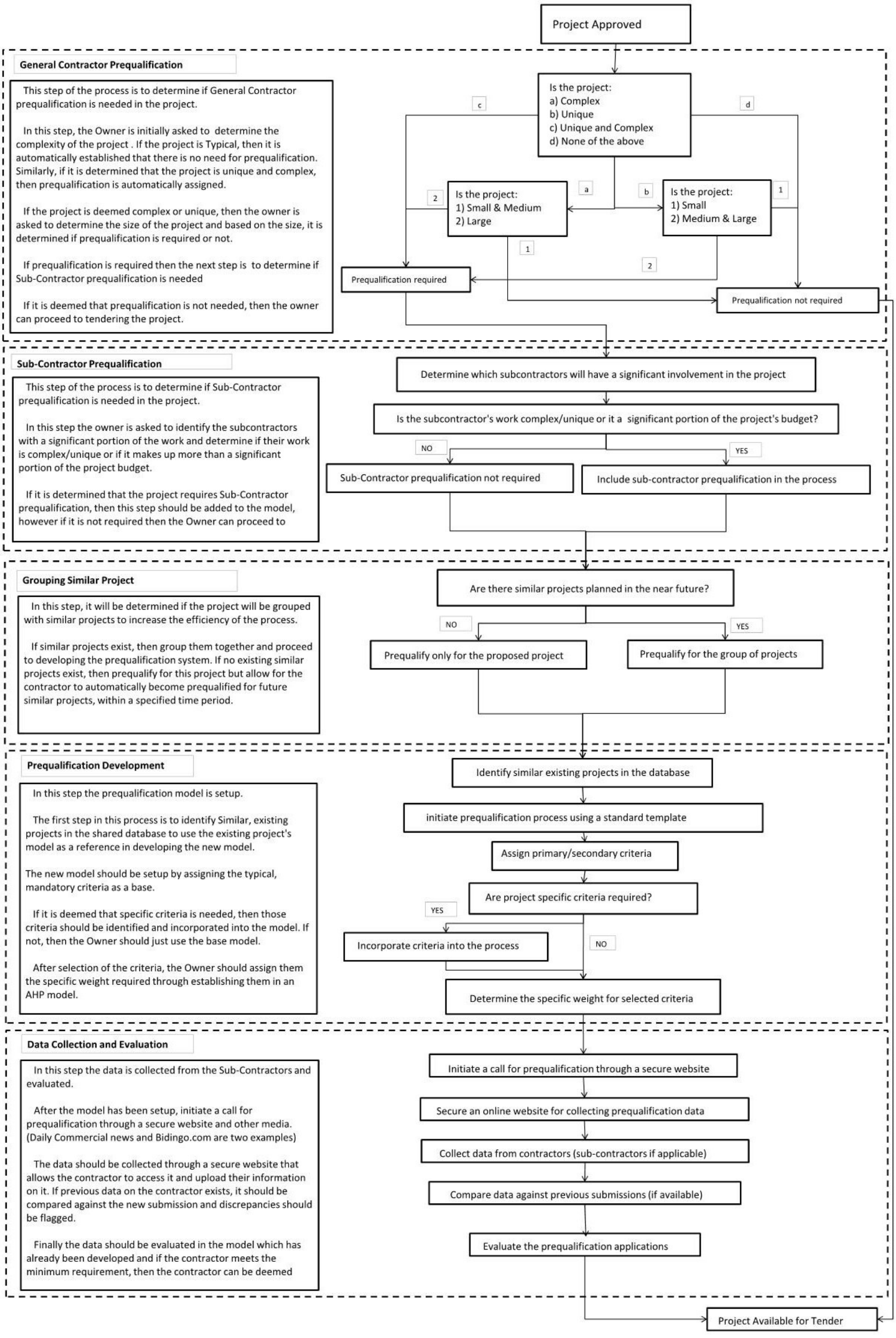

Figure 11: General Implementation Process

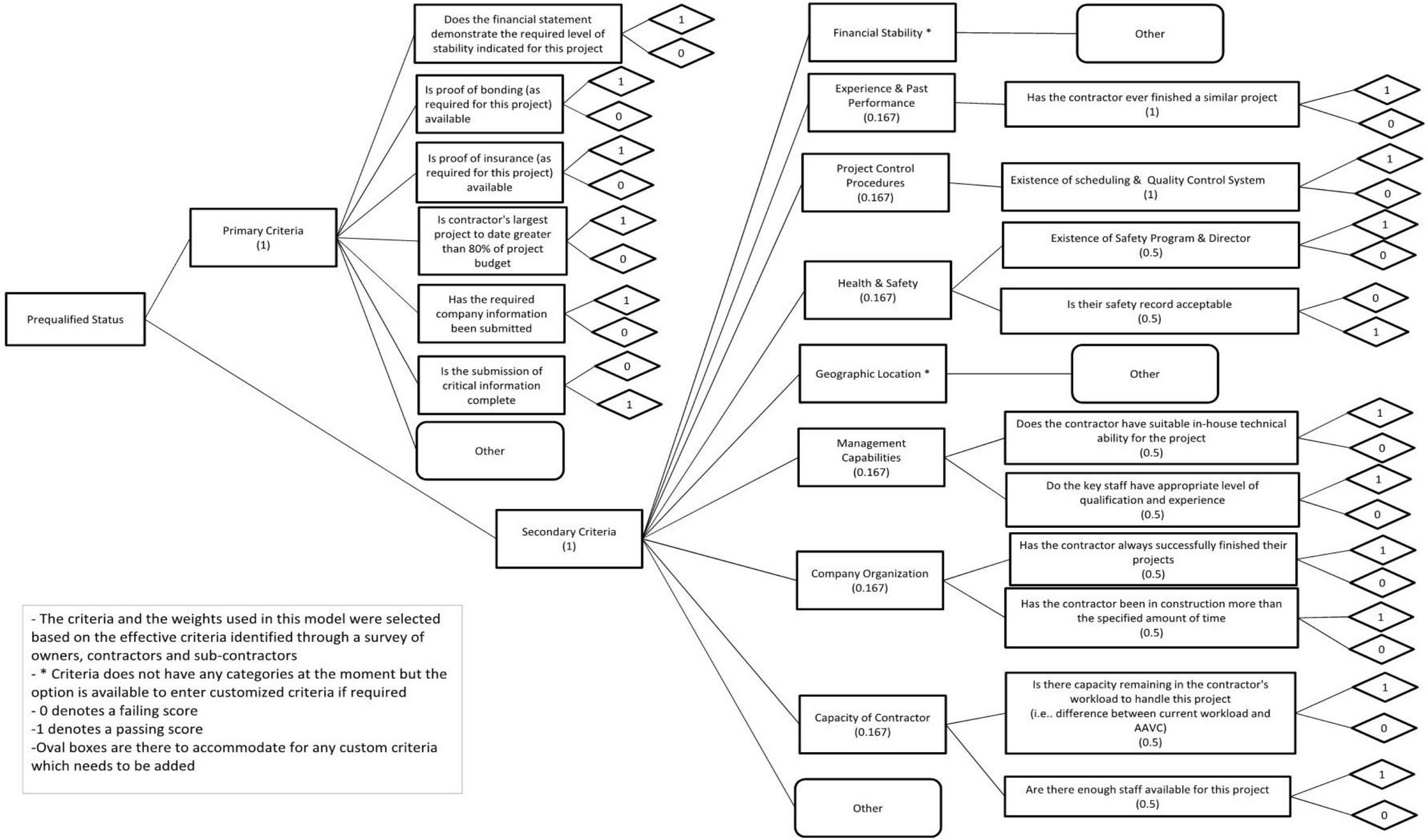

Figure 12: Typical Decision Criteria

4.2 Example

4.2.1 --- Project Description:

After approving the redevelopment of a hospital, Owner ABC is looking to hire a contractor to manage the construction of an upgraded hospital and procurement of the associated equipment and controls with a budget of $300,000,000. They also require the contractor to commission the equipment to ensure that everything is in operating condition before the project is turned over to the municipality. The project consists of redevelopment of the existing hospital and addition of the neighboring building and parking lot to the hospital. Since the hospital is currently operational, the owner requires the contractor to ensure that the construction is staged in a way that the hospital remains operation at all times. Further, they need a contractor who is signatory to the building trade unions. They want the project to be able to qualify for LEED Silver Certification.

4.2.2 --- Prequalification Process

Figure 14 demonstrates the process for determining whether prequalification is recommended and the steps required for development of an appropriate prequalification process. The path taken for setting up the process for this project has been highlighted for clarity. Construction of this project is a complex procedure as a hospital contains a significant amount of electrical and mechanical systems that need to be integrated in the building. The transition of the old hospital to the new hospital and the requirement for a temporary facility also adds to the complexity of the project and gives it a unique element. The budget associated with the project is also quite large. All these factors make prequalification necessary for this project. Also since a big portion of the work will be handled by the mechanical and the electrical subcontractors, it is recommended that these sub-contractors to be prequalified. Similar projects of this nature are not planned in the near future by the owner, however a clause should be included which would make the contractors automatically prequalified for projects similar to this within the next 2 years.

This project is a LEED certifiable project hence the qualifying contractor should have LEED associate professionals employed in their staff. This additional criterion should be used in

addition to the recommended primary/secondary criteria. Figure 15 shows the recommended criteria used for this project.

4.2.3 --- Hypothetical Contractor

As a step to fully set up this model, it is proposed that a contractor with the following description to be used as the hypothetical contractor used in the evaluation process:

4.2.3.1 Primary Criteria:

- P1 - Financial statement should demonstrate that the contractor has the capacity to handle a project with a $300 Million budget
- P2 - Performance bonding available for up to 20% of the project budget (i.e. 0.2*300=$60 Million)
- P3 - Insurance coverage for the cost of project
- P4 - Largest project to date greater than 80% of project budget ($240 Million)
- P5 - Contractors has submitted all the required company's organizational information
- P6 – Contractor has submitted all critical information required
- P7 - The company currently employs a LEED Associated Professional available for this project

4.2.3.2 Secondary Criteria:

- S1 - Completed 1 similar projects within the past 5 years, respectively worth 80% of the project budget or more (i.e. 0.8*300=$240 Million)
- S2 - Currently uses Primavera for project control and uses online tools like Sharepoint and CMIC for correspondence and record keeping. Has ability to use BIM in the project
- S3 - Currently has a safety program and employs 3 safety directors
- S4 - CAD 7 rating of 0.5 or higher
- S5 - Has to have 4 engineers with P.Eng in Ontario available for this project
- S6 - The company's Management team should contain at least 10 senior project managers with 20+ years of experience and with recognized professional designations
- S7 - Never failed to complete a project

- S8 - Has been in construction for more than 20 years
- S9 - Average annual value of construction (AAVC) over past five years to be greater than 80% of project budget (i.e. 0.8*300=$240 Million)
- S9 - Current workload should be less than the difference of AAVC and 80% of annual cost of construction for this project (i.e. 240-0.8(300/5)=$192 Million)
- S10 - Has at least 5 labors and 2 carpenters available for this project

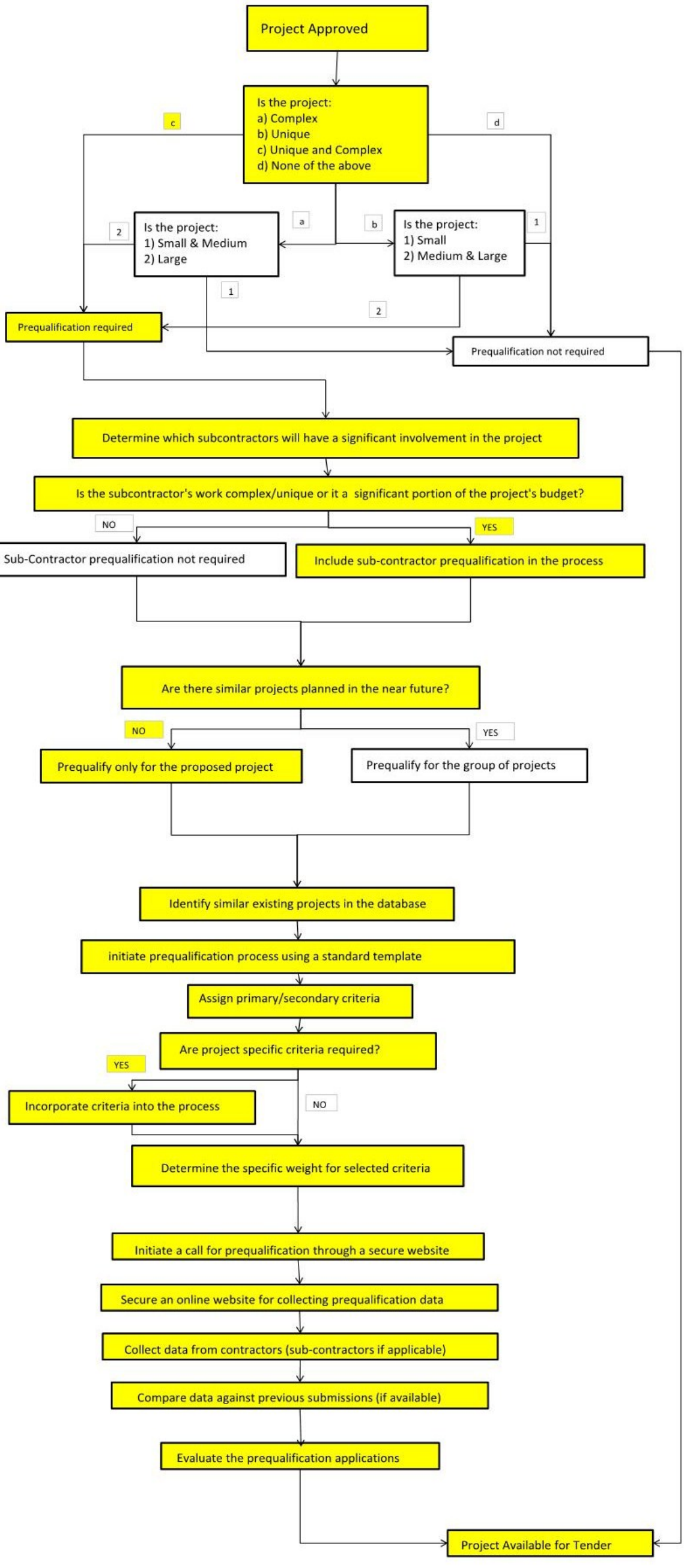

Figure 13: Implementation Process

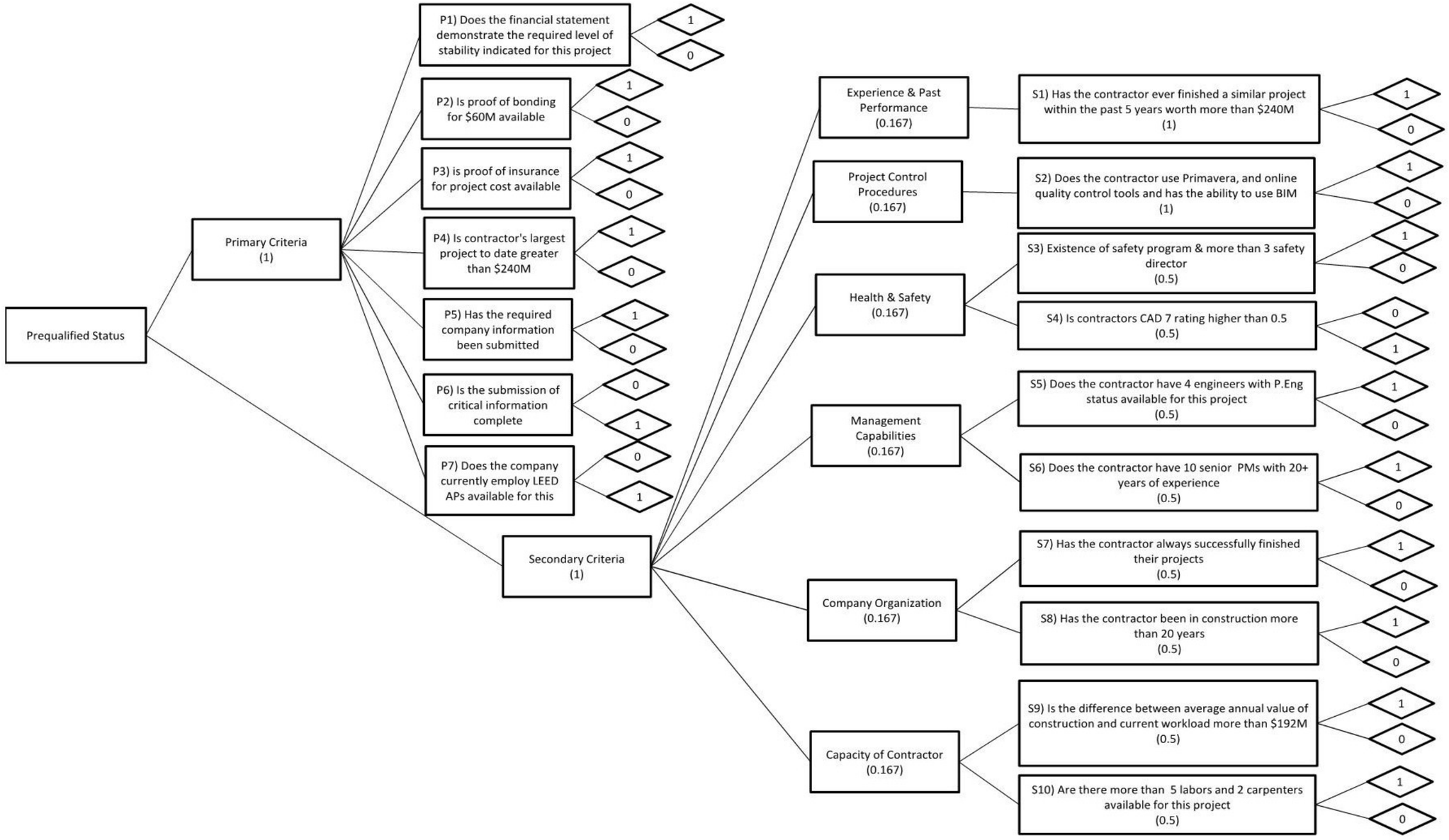

Figure 14: Decision Criteria

4.3 Industry Feedback

To ensure that the developed model is practical in real life and that it provides improvement over current practices in the field, it was presented to several owners who initially participated in the surveys. In the professional opinion of the review participants, the proposed model met the functionality requirements and it proposed improvements to some of the current systems used in the industry. Simplicity and ease of use were two characteristics which were identified by the reviewers. It was indicated that the model focuses on functionality and that it aims at making the prequalification process, including evaluation, easily understandable.

It was indicated that the model streamlines the evaluation process and that it improves transparency through the elimination of subjective reasoning, which is the current practice at most municipalities. This fits within the overall objective of the model which is to develop a model that is understandable, cost efficient and transparent. Through the use of a pass or fail score for primary criteria, it requires the evaluation of fewer criteria, making data collection and evaluation more efficient.

The model was also presented to the Ontario Construction Secretariat (OCS) at their monthly board of directors meeting. The meeting was attended by OCS staff and industry experts representing stakeholders in the construction industry. The feedback in that meeting was positive and the model was recognized as simple, effective and transparent.

Chapter 5
Conclusion

5 Conclusion

Through this research the practices of the public owners in the southern Ontario region were investigated. The existing literature indicated that prequalification is one of the most effective ways through which public owners can enhance their procurement practices without taking away the competitiveness of this process. Overall the objective of this research was to identify how prequalification improves a project and some feasible ways through which prequalification can be implemented or enhanced. This objective was achieved by surveying industry experts to determine the effectiveness of those practices. The participants in the surveys provided information about the details of prequalification practices, the effects of those practices on the implementation phase of the project and the overall effectiveness of some of the practices and criteria used in the process. By using the findings of this study, public owners can alter their prequalification practices in a way that would allow them to acquire a better value for their money. The findings demonstrated that:

- Prequalification is an effective process in acquiring a competent contractor which can result in lower cost escalations, higher quality of the final project and better safety records as demonstrated on pages **Error! Bookmark not defined.**, 23 and 24.
- Projects with prequalification exhibited enhanced cooperation between the contractor, owner and consultants as discussed on page 17.
- Although prequalification creates an obstacle in the way of newer contractors, this obstacle is necessary to protect the owners. Newer contractors should acquire the necessary experience through smaller and less complex projects as specified on page20.
- Overall, the opinions of the owners, contractors and sub-contractors did not vary often, however differences in opinion were observed in some categories and they should be addressed. As observed through studying each category in greater detail, the three group

disagreed on the importance of some of the categories. This variation in perspective could be attributed to how these sub-categories affect them in the procedure, and some with the greatest variance in perspective should be looked at in greater detail. One example that demonstrates this really well is the difference in opinion regarding WSIB ratings and it should be investigated if this criterion is really prejudice towards sub-contractors, as discussed on page 39.

- It is observed that for the owners in the region, bonding capacity is the best indication of financial stability and use of this criterion to establish financial stability is very efficient as discussed on page 27.

The best practices that were identified in this research are:

1. Municipalities can achieve a better value by prequalifying contractors on a group of projects.
2. Using electronic documents is an effective methods of increasing the efficiency of the process.
3. Using a standardized system and centralized process is an effective method of increasing the efficiency of the process.
4. Using only a selected number of question that bring a high value added to the process has the potential to increase the efficiency of the prequalification process
5. Prequalification of subcontractors, consultants and designers ensures competent trades and designers are participating in the project.

The more effective criteria identified in the opinion survey, are:

1. Financial Statement

2. Bonding Capacity

3. Has the contractor ever failed to complete a contract

4. Number of similar completed projects

5. Types of projects completed

6. Appropriateness of scheduling system

7. Appropriateness of safety program

8. Existence of contractor safety program and director

9. Number of accidents in the last 3 years

10. In-house technical ability

11. Qualification of key staff

12. Experience of key personnel

13. Number of failures to complete a contract

14. Number of years in construction

15. Experience of employees (field/labor)

16. Contractor's largest project completed to date

17. Staff available or this specific project

The developed model incorporated these findings into a process that owners can follow to establish the need for prequalification and to determin the selection criteria. The model was

developed to improve on the weaknesses observed in existing models. The proposed model provides a process that is objective, effective, transparent and user-friendly.

Chapter 6
Further Research

6 Further Research

To determine the functionality of this model, it is proposed that this model should be compared against other existing and more complicated models to determine how the results vary. This requires collection of data from owners regarding previous projects and previous submission by contractors. Through comparison of the models, it can be establish that if the new model can produce similar results as the more complicated and data intensive model. The findings can then be used to strengthen the model's decision making tool. Ultimately it is hoped that a complete model can be developed that includes a complete step by step process and an effective decision making tool that can be used by the owners to enhance their procurement process.

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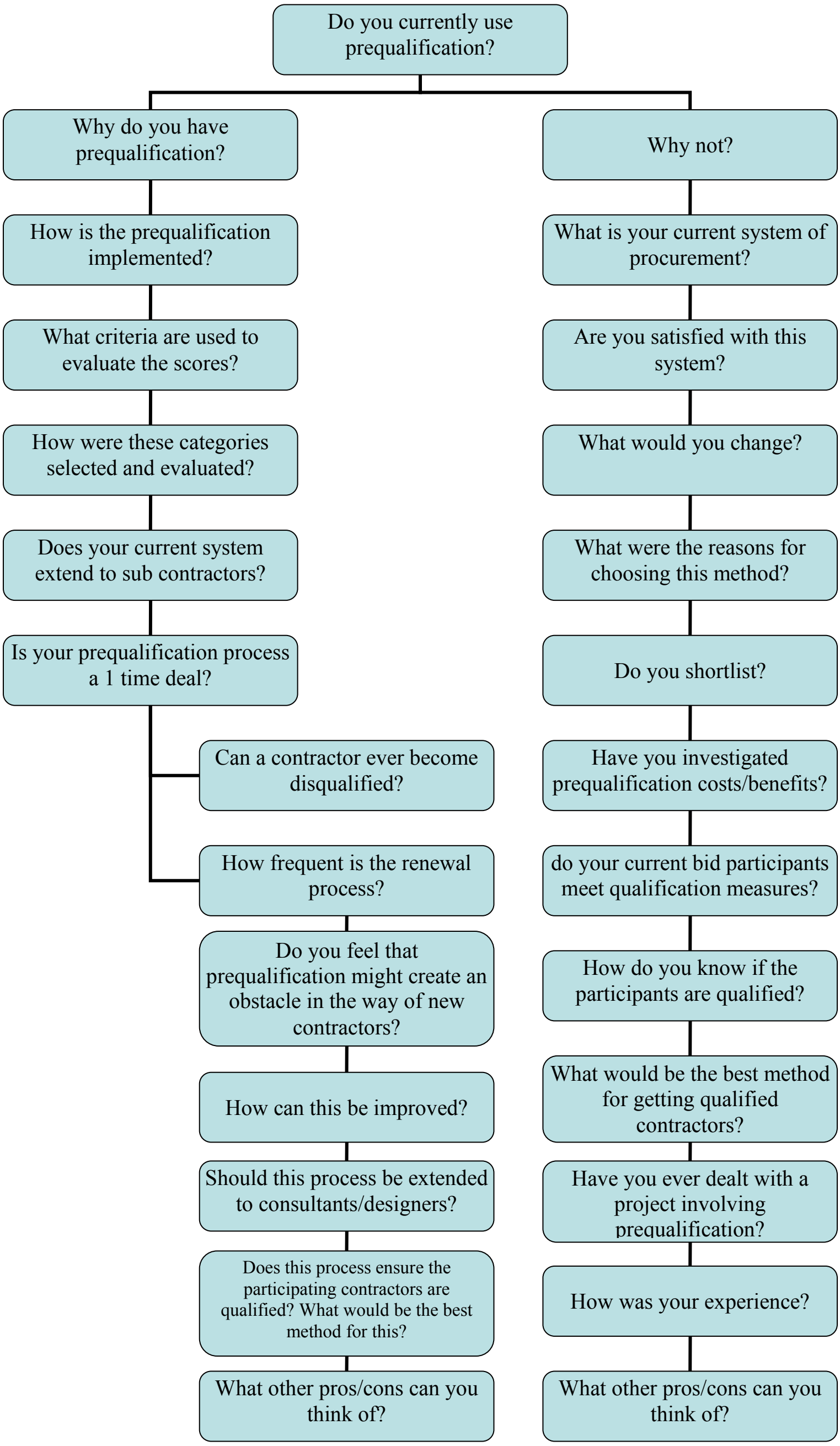
Appendix A


Do you currently use prequalification?
Why do you have prequalification?
How is the prequalification implemented?
What criteria are used to evaluate the scores?
How were these categories selected and evaluated?
Does your current system extend to sub contractors?
Is your prequalification process a 1 time deal?
Can a contractor ever become disqualified?
How frequent is the renewal process?
Do you feel that prequalification might create an obstacle in the way of new contractors?
How can this be improved?
Should this process be extended to consultants/designers?
Does this process ensure the participating contractors are qualified? What would be the best method for this?
What other pros/cons can you think of?
Why not?
What is your current system of procurement?
Are you satisfied with this system?
What would you change?
What were the reasons for choosing this method?
Do you shortlist?
Have you investigated prequalification costs/benefits?
do your current bid participants meet qualification measures?
How do you know if the participants are qualified?
What would be the best method for getting qualified contractors?
Have you ever dealt with a project involving prequalification?
How was your experience?
What other pros/cons can you think of?

Appendix B

PREQUALIFICATION EVALUATION SURVEY

1. THANK YOU FOR PARTICIPATING IN THIS SURVEY

Thank you for agreeing to participate in this brief survey on Pre-Qualification as a best practice for public sector procurement. This research is being completed for the Ontario Construction Secretariat by Payman Berjis a masters student at the University of Toronto's department of Civil Engineering.

The survey should take 10-15 minutes to complete and all responses are confidential.

PREQUALIFICATION EVALUATION SURVEY

2. PART I: PERSONAL/COMPANY INFORMATION

*1. Name:

*2. Title:

*3. Company:

*4. Years of experience (person):

*5. Years of experience (company):

*6. Years with company:

*7. Location:

*8. Whose point of view do you represent:

- Owner
- General Contractor
- Consultant
- Sub-Contractor
- Construction Manager

Other (please specify)

9. Is your firm signatory, or bound to any construction collective agreements? (That is you must utilize unionized labour for your construction projects)

- Yes
- No
- Not Applicable

10. What percentage of your work, roughly, involves public contracts (%):

PREQUALIFICATION EVALUATION SURVEY

11. Please specify what percentage of your work, roughly, represents the following categories (%):

New

Renovation/Alteration

Maintenance/Repair

12. Please specify what percentage of your work, roughly, represents the following categories:

Buildings

Roads/Utilities

13. Please specify the average size of your contracts within the past 5 years ($):

Small

Medium

Large

14. What percentage of the projects that you bid on required prequalification (%):

15. What percentage of the prequalification requirements are (%):

For a project

For an organization (i.e. MTO)

PREQUALIFICATION EVALUATION SURVEY

3. PART II: PREQUALIFICATION EVALUATION

1. Prequalification is a good process...

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
for determining the competence of potential candidates	○	○	○	○	○
for reducing the owner's risk	○	○	○	○	○
for lowering contractors overall bidding costs	○	○	○	○	○
for reducing cost escalation	○	○	○	○	○
for minimizing delays	○	○	○	○	○
for eliminating the need for bid bonds	○	○	○	○	○
for increasing the overall quality of the project	○	○	○	○	○
for reducing safety risks involved in the project	○	○	○	○	○
for reducing contractor initiated change order	○	○	○	○	○
for reducing owner initiated change order	○	○	○	○	○
for creating an obstacle for the new contractors to enter the market	○	○	○	○	○
when it is based on the experience of the employees rather than the company	○	○	○	○	○
when it is based on the experience of the company rather than the employees	○	○	○	○	○
when there is a standardized process for all public owners	○	○	○	○	○
when it is extended to the sub contractors	○	○	○	○	○
when it is extended to the designers and consultants	○	○	○	○	○
when the documents are prepared by a third party consultant specializing in prequalification (on behalf of the contractor)	○	○	○	○	○
when the process is prepared by a third party consultant specializing in prequalification (on behalf of the owner)	○	○	○	○	○

PREQUALIFICATION EVALUATION SURVEY

4. PART III: CRITERIA EVALUATION

Please provide your opinion of the effectiveness of the following categories in selection of a qualified contractor

1. Financial Stability

	Very Ineffective	Ineffective	Neutral	Effective	Very Effective
Credit rating	○	○	○	○	○
Letter of reference from bank	○	○	○	○	○
Financial statement	○	○	○	○	○
Bonding capacity	○	○	○	○	○
Availability of line of credit	○	○	○	○	○

2. Experience & Past Performance

	Very Ineffective	Ineffective	Neutral	Effective	Very Effective
Types of projects completed	○	○	○	○	○
Number of similar completed projects	○	○	○	○	○
Frequency of projects completed over schedule	○	○	○	○	○
Frequency of projects completed over budget	○	○	○	○	○
Frequency of change orders in previous projects	○	○	○	○	○
Has the contractor ever failed to complete a contract	○	○	○	○	○
Has the contractor ever been banned from bidding due to previous projects	○	○	○	○	○
Number of times claims have gone to litigation	○	○	○	○	○
Number of times claims have gone to arbitration/mediation	○	○	○	○	○
Volume of deficiencies in previous projects	○	○	○	○	○
References from previous clients	○	○	○	○	○

PREQUALIFICATION EVALUATION SURVEY

3. Capacity of the Contractor

	Very Ineffective	Ineffective	Neutral	Effective	Very Effective
Contractor's largest project completed to date	○	○	○	○	○
Last year's construction in volume $	○	○	○	○	○
Average construction volume over last 5 years $	○	○	○	○	○
Current backlog of work $	○	○	○	○	○
Current Workload $	○	○	○	○	○
Current number of employees (office/management)	○	○	○	○	○
Current number of employees (field/labor)	○	○	○	○	○
Number of employees averaged over the last 3 years	○	○	○	○	○
Experience of employees (field/labor)	○	○	○	○	○
Amount of work performed with own forces	○	○	○	○	○
Employee turnover	○	○	○	○	○
Staff available for this specific project	○	○	○	○	○
Number of engineers/architects employed	○	○	○	○	○
Experience of labor	○	○	○	○	○
Existence of a formalized company training program	○	○	○	○	○
Existence of a formalized apprenticeship program	○	○	○	○	○
Adequate equipment available	○	○	○	○	○
Suitability of owned equipment for this project	○	○	○	○	○

PREQUALIFICATION EVALUATION SURVEY

4. Project Control Procedures

	Very Ineffective	Ineffective	Neutral	Effective	Very Effective
Appropriateness of safety program	○	○	○	○	○
Appropriateness of cost control and reporting system	○	○	○	○	○
Appropriateness of scheduling system	○	○	○	○	○
Appropriateness of control/policy/assurance program	○	○	○	○	○
Sophistication of control procedures	○	○	○	○	○
Previous experience with these procedures	○	○	○	○	○
Judgment as to whether management is able to use the procedures effectively	○	○	○	○	○
Environmental plans	○	○	○	○	○
Traffic control plans	○	○	○	○	○

5. Geographic Location

	Very Ineffective	Ineffective	Neutral	Effective	Very Effective
Location of home office	○	○	○	○	○
Experience in geographic location of project	○	○	○	○	○
Contractor's familiarity with local weather conditions	○	○	○	○	○
Contractor's familiarity with local labor agreements	○	○	○	○	○
Contractor's familiarity with local politics	○	○	○	○	○
Market conditions of the geographic area	○	○	○	○	○
Contractor's familiarity with subsurface characteristics	○	○	○	○	○

PREQUALIFICATION EVALUATION SURVEY

6. Health & Safety

	Very Ineffective	Ineffective	Neutral	Effective	Very Effective
Number of accidents in the last 3 years	○	○	○	○	○
Existence of contractor safety program and director	○	○	○	○	○
WSIB rating	○	○	○	○	○
Contractor's diligence in conducting tool box meetings	○	○	○	○	○
Substance abuse policy	○	○	○	○	○
Has any of the contractor's previous job sites ever been closed due to a safety infraction	○	○	○	○	○

7. Management Capabilities

	Very Ineffective	Ineffective	Neutral	Effective	Very Effective
Experience of key personnel	○	○	○	○	○
Turnover of management	○	○	○	○	○
Qualification of key staff	○	○	○	○	○
Complexity of past projects	○	○	○	○	○
In-house technical ability	○	○	○	○	○
Appropriateness of project organizational chart	○	○	○	○	○
Frequency of manager's projects completed over schedule	○	○	○	○	○
Frequency of manager's projects completed over budget	○	○	○	○	○
Frequency of manager's project deficiencies	○	○	○	○	○
Decision making power in the field	○	○	○	○	○
Amount of work performed with own forces on past projects	○	○	○	○	○

PREQUALIFICATION EVALUATION SURVEY

8. Company Organization

	Very Ineffective	Ineffective	Neutral	Effective	Very Effective
Type of ownership	○	○	○	○	○
Number of years in construction	○	○	○	○	○
Contractor;s licenses held	○	○	○	○	○
Number of failures to complete a contract	○	○	○	○	○
Appropriateness of company organization structure	○	○	○	○	○

PREQUALIFICATION EVALUATION SURVEY

5. PART IV: GENERAL CATEGORIES

1. Please evaluate the following GENERAL CATEGORIES based on their effectiveness in selecting a qualified candidate:

	Very Ineffective	Ineffective	Neutral	Effective	Very Effective
Financial Stability	○	○	○	○	○
Experience & Past Performance	○	○	○	○	○
Capacity of Firm	○	○	○	○	○
Project Control Procedures	○	○	○	○	○
Geographic Location	○	○	○	○	○
Health & Safety	○	○	○	○	○
Management Capabilities	○	○	○	○	○
Company Organization	○	○	○	○	○

Appendix C

Prequalification Followup

1. Prequalification Followup

I would like to thank you for taking the time to complete the first part of the survey. I would appreciate it if you could take 5-10 minutes from your time to finish the follow up survey which aims at assessing the prequalification process of local municipalities. I can ensure you that this part of the survey is completely anonymous and no one would be able to see who has answered the questions.

Once again thank you for your cooperation,

Payman Berjis

Prequalification Followup

2.

***1. Have you ever prequalified for any of the following entities:**

- ☐ Burlington
- ☐ Hamilton
- ☐ London
- ☐ Toronto
- ☐ York region
- ☐ Toronto District School Board
- ☐ UofT
- ☐ Defense Construction
- ☐ Markham
- ☐ Mississauga
- ☐ Region of Peel
- ☐ Region of Waterloo
- ☐ none of the obove

Prequalification Followup

3.

*** 1. Do you represent a contractor or a contract administrator?**

- Contractor
- CA

Prequalification Followup

4. Contractors

1. What are some of the differences in the prequalification process terms of:

-Bidding

-Criteria

-Effectiveness

-Transparency (Criteria, Scoring)

2. How often do you:

submit prequalification packages

submit proof of bonding

3. Which municipality's prequalification process made it easier to work with them, which ones made it harder?

4. What are some differences (on site, during construction) between projects that use prequalification and the ones that don't?

5. Do you believe that there is a lower limit (in terms of cost of projects) for prequalification or maybe one prequalificaiton process for all of the smaller projects?

6. Is prequalification process better used when it is used on a project by project basis, or when used for prequalifying for a pool of projects?

Prequalification Followup

5. CAs

1. Were you involved in the prequalification process?

2. Which municipality's prequalification process made it easier to work with them, which ones made it harder?

3. Point to a difference between projects that have prequalification vs. ones that do not:

4. What are some differences (on site, during construction) between projects that use prequalification and the ones that don't?

5. Do you believe that there is a lower limit (in terms of cost of projects) for prequalification or maybe one prequalificaiton process for all of the smaller projects?

6. Is prequalification process better used when it is used on a project by project basis, or when used for prequalifying for a pool of projects?